

**Statement by NASA Administrator Daniel S. Goldin
concerning Radiation Testing on Humans**

On December 30, 1993, my office was informed by the Department of Energy that, during the 1960s and 70s, NASA was involved in sponsorship or cosponsorship of some human experiments to determine the effects of radiation. I personally consider this issue to be of paramount concern and will ensure that any involvement by NASA is fully disclosed to the American public. Therefore, I have taken the following immediate steps:

1. I have assigned Dr. Harry C. Holloway, Associate Administrator for Life & Microgravity Sciences & Applications, the responsibility of overseeing all of NASA's internal activities regarding human experimentation on the effects of radiation. He will participate in an interagency meeting at the White House this afternoon concerning research on this issue and how the government should proceed.

2. I have appointed a team, led by Dr. Donald E. Robbins, Deputy Director of Space and Life Sciences at the Johnson Space Center, to conduct a prompt but detailed search of all NASA records concerning human experiments involving radiation. The team will report to Dr. Holloway and will cooperate fully with external review bodies, the Department of Energy and other federal agencies involved in this issue.

Today's NASA prides itself on its openness, its relevancy and its positive impact on the quality of life for all people. There is no place in this agency for human medical experimentation conducted in secrecy or without full respect for the human dignity of each and every participant. I guarantee the American public a full accounting of all radiation experiments conducted on human subjects by this agency.

January 3, 1994

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 453-8400



For Release

Drucella Andersen
Headquarters, Washington, D.C.
(Phone: 202/358-4727)

January 3, 1994

EDITORS NOTE: NASA "INTERNET IN THE CLASSROOM" VIDEO AVAILABLE

NASA has released a new 12-minute video that shows educators how they can use the Internet electronic network as a dynamic and effective teaching tool.

The video, entitled "Global Quest: The Internet in the Classroom," shows students and teachers how to carry out classroom assignments using online electronic communications. It serves as an introduction to accessing the almost unlimited worldwide information resources -- including images, current science data and conversations with other students, teachers and experts -- available to educators via the Internet.

The video will be played on NASA Select television (EST) on Jan. 3, 1994, 2 p.m.; Jan. 6, 1:30 p.m.; Jan. 11, 12:30 p.m.; Jan. 13, 2:30 p.m.; Jan. 18, 1 p.m.; and Jan. 25, 2 p.m.

It also is available by contacting the NASA Central Operation of Resources for Educators, Lorain County Joint Vocational School, Oberlin, Ohio, 216/774-1051, ext. 293/294 (fax: 216/774-2144).

"Global Quest: The Internet in the Classroom" was produced by NASA's National Research and Education Network project, part of the multi-agency High-Performance Computing and Communications Program. One of NASA's roles is to pioneer and apply new technology that will help raise the quality of U.S. science and mathematics education.

- end-

For Release

Donald L. Savage
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January 3, 1994

EDITORS NOTE: N94-1

MARS OBSERVER INVESTIGATION REPORT MEDIA BRIEFING

The final report of the independent board named to investigate the failure of the Mars Observer mission will be presented at a media briefing at the NASA Headquarters auditorium, 300 E Street, S.W., Washington, D.C., at 1 p.m. EST, Jan. 5.

Dr. Timothy Coffey, Director of Research at the Naval Research Laboratory, Washington, D.C., will present the board's findings, recommendations and the process by which they reached their conclusions. The Mars Observer Mission Failure Review Board report will be available to news media representatives at the briefing.

Also on the panel will be Dr. Wesley Huntress, Jr., Associate Administrator for NASA's Office of Space Science, Washington, D.C. and Dr. Edward Stone, Jr., Director of NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif. The Mars Observer mission was managed by JPL for the Office of Space Science.

Dr. Coffey was appointed Chairman of the board by NASA Administrator Daniel Goldin following the loss of communication with the Mars Observer spacecraft on Aug. 21. Coffey named the five board members who began their investigation in September.

The briefing will be carried live on NASA Select television with two-way question and answer capability at NASA centers. NASA Select television is available on SATCOM F2R, 72 degrees West longitude, audio 3600 MHz.

- end -

For Release

Dwayne C. Brown
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January 4, 1994

NOTE TO EDITORS: N94-2

NASA TELEVISION SYSTEM TO BE RECONFIGURED

On Jan. 8, 1994, at 10:00 a. m. EST, NASA's television system, NASA Select, will be reconfigured to transmit on a different satellite transponder. Transmissions will be on Spacenet 2, transponder 5, located at 69 degrees West with horizontal polarization. Frequency will be on 3880.0 Megahertz, audio on 6.8 Megahertz.

This reconfiguration may affect your ability to receive and distribute NASA Select transmissions. NASA Select video and audio over the transponder you are presently viewing (Satcom F-2R, transponder 13) will be discontinued.

NASA Select is an agency-wide TV-audio system offering a wide range of programming, including coverage of Space Shuttle flights and other NASA mission activities. Unless noted, all programming carried on NASA Select may be taped for rebroadcast and other uses.

- end -

NASA News

National Aeronautics and
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For Release

Sarah Keegan
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January 4, 1993

NOTE TO EDITORS: N94-3

HUBBLE TELECON CANCELLED

The telecon on the status of the Hubble Space Telescope (HST) servicing mission observatory verification process previously scheduled for Wednesday, January 5, 1994, at 12:00 noon EST has been cancelled. Activities continue to go extremely well; there are no problems or issues to report.

Last week the HST team made small adjustments in telescope focus to prepare for Wide Field/Planetary Camera II (WF/PC-II) test science images; began the process of collecting test images on science targets; performed the first focus and alignment iteration on the Faint Object Camera (FOC)/COSTAR combination; and determined the new light path through COSTAR to the Faint Object Spectrograph (FOS).

This week the team will begin the process of collecting test science images for FOC/COSTAR; continue collecting WF/PC-II test science images; and perform detailed reduction and science analysis of images taken to date.

The HST team is concentrating its efforts on processing images it hopes to release publicly on January 13, 1994. More details will be announced as they are finalized.

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For Release
January 5, 1994

STATEMENT BY NASA ADMINISTRATOR DANIEL S. GOLDIN ON THE MARS OBSERVER INVESTIGATION REPORT

"Today NASA received the report of the independent board charged with investigating the loss of the Mars Observer mission. I am extremely gratified that the board, chaired by Dr. Timothy Coffey of the Naval Research Laboratory, turned in a professional report. Their analysis was fair, exhaustive and technically rigorous.

"I have just asked Dr. Wes Huntress (Associate Administrator for NASA's Office of Space Science) to conduct a thorough review of the findings and recommendations. He will report back to me in the near future on the corrective actions that will be taken by NASA to preclude the types of problems we encountered during this mission.

"NASA works on the cutting edge of science and technology, and space is a harsh environment in which to work. However, the Coffey report also candidly pointed out management and technical concerns that must be addressed. I am confident that NASA and our contractors will learn valuable lessons for the future.

"I am proud of NASA's continuing openness in the handling of Mars Observer failure. The spotlight that we put on today's report was similar to the way we opened our doors to the world when the spacecraft was first lost. We believe the American public deserves a full accounting and we will take the appropriate corrective actions.

"We have a number of planetary exploration missions planned for the coming decade which promise to greatly expand our knowledge of the solar system and pave the way for exciting missions in the next century. Therefore, it is imperative that we fully grasp the lessons provided by Dr. Coffey and his team."

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National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 453-8400

Donald L. Savage
Headquarters, Washington, D.C.
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For Release
January 5, 1994

Michael Finneran
Goddard Space Flight Center, Greenbelt, Md.
(Phone: 301/286-5565)

RELEASE: C94-a

CALIF. INSTITUTE OF TECHNOLOGY AWARDED \$39.8 MILLION CONTRACT

NASA has awarded a 4-year, \$39.8-million contract to the California Institute of Technology (CIT) in Pasadena, Calif., for the design and development phase of the Advanced Composition Explorer (ACE) science payload.

ACE, managed by NASA's Goddard Space Flight Center, Greenbelt, Md., is scheduled for launch in the third quarter of 1997.

The cost contract is for the phase C/D design and development of the science payload consisting of nine instruments to be flown on the ACE spacecraft. The university will provide the facilities, materials, services, personnel and subcontracts needed to manage the development of instrument hardware to perform ACE scientific measurements. CIT will provide the Solar Isotope Spectrometer and the Cosmic Ray Isotope Spectrometer.

CIT will subcontract for the following instruments:

- * Solar Wind Ionic Mass Spectrometer, the Solar Wind Ionic Composition Spectrometer and part of the Ultra Low Energy Isotope Spectrometer (ULEIS) from the University of Maryland, College Park.
- * Solar Energetic Particle Ionic Charge Analyzer for the University of New Hampshire in Durham.
- * Magnetometer for the University of Delaware in Newark and Goddard.

Goddard separately will procure the Energetic Electron, Proton and Alpha-particle Monitor and part of ULEIS from the Applied Physics Laboratory in Laurel, Md., and the Solar Wind Electron, Proton and Alpha-particle Monitor from the Los Alamos National Laboratory in New Mexico.

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Responsibility for technical management of these instruments will be delegated to CIT, who also will establish and maintain the ACE Science Center (ASC) for the analysis and archiving of science data.

Also under this contract, CIT will provide support to mission operations for 30 days after launch, at which time the science center and mission operations support will be transferred to a separate contract.

The ASC will process the science data from the ACE mission, distribute the data to the science team and provide for the archiving of the data.

The contract is a continuation of CIT participation in the ACE mission concept, which resulted from a competitive selection from responses to NASA Headquarters Space Science and Applications Notice for the Explorer Concept Study Program dated March 14, 1986.

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 453-8400

For Release

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January 5, 1994
EMBARGOED UNTIL 1PM EST

James Gately
Naval Research Laboratory, Washington, D.C.
(Phone: 202/767-2541)

RELEASE: 94-1

MARS OBSERVER INVESTIGATION REPORT RELEASED

The final report by the independent investigation board on the failure of the Mars Observer spacecraft was delivered today to NASA Administrator Daniel S. Goldin by Dr. Timothy Coffey, Chairman of the board. Dr. Coffey is Director of Research at the Naval Research Laboratory, Washington, D.C.

The Mars Observer spacecraft was to be the first U.S. spacecraft to study Mars since the Viking missions 18 years ago. The Mars Observer spacecraft fell silent just 3 days prior to entering orbit around Mars, following the pressurization of the rocket thruster fuel tanks.

Because the telemetry transmitted from the Observer had been commanded off and subsequent efforts to locate or communicate with the spacecraft failed, the board was unable to find conclusive evidence pointing to a particular event that caused the loss of the Observer.

However, after conducting extensive analyses, the board reported that the most probable cause of the loss of communications with the spacecraft on Aug. 21, 1993, was a rupture of the fuel (monomethyl hydrazine (MMH)) pressurization side of the spacecraft's propulsion system, resulting in a pressurized leak of both helium gas and liquid MMH under the spacecraft's thermal blanket. The gas and liquid would most likely have leaked out from under the blanket in an unsymmetrical manner, resulting in a net spin rate. This high spin rate would cause the spacecraft to enter into the "contingency mode," which interrupted the stored command sequence and thus, did not turn the transmitter on.

Additionally, this high spin rate precluded proper orientation of the solar arrays, resulting in discharge of the batteries. However, the spin effect may be academic, because the released MMH would likely attack and damage critical electrical circuits within the spacecraft.

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The board's study concluded that the propulsion system failure most probably was caused by the inadvertent mixing and the reaction of nitrogen tetroxide (NTO) and MMH within titanium pressurization tubing, during the helium pressurization of the fuel tanks. This reaction caused the tubing to rupture, resulting in helium and MMH being released from the tubing, thus forcing the spacecraft into a catastrophic spin and also damaging critical electrical circuits.

Based on tests performed at the Jet Propulsion Laboratory (JPL) Pasadena, Calif., the board concludes that an energetically significant amount of NTO had gradually leaked through check valves and accumulated in the tubing during the spacecraft's 11-month flight to Mars.

In addition, the report listed other possible causes of the loss of the spacecraft as:

- * failure of the electrical power system, due to a regulated power bus short circuit;
- * NTO tank over-pressurization and rupture due to pressurization regulator failure;
- * the accidental high-speed ejection of a NASA standard initiator from a pyro valve into the MMH tank or other spacecraft system.

Other concerns noted by the board included:

- * a need to establish a policy to provide adequate telemetry data of all mission-critical events;
- * the lack of post-assembly procedures for verifying the cleanliness and proper functioning of the propellant pressurization system;
- * a current lack of understanding of the differences between the characteristics of European Space Agency and NASA pyro-initiators;
- * the potential for power bus short circuits, due to single component or insulation failure;
- * the potential for command and data handling control systems to be disabled by single-part failure;
- * the lack of fault protection external to the redundant crystal oscillator (RXO) should one of its two outputs fail;
- * the absence of information, in the telemetry, on the actual state of the RXO's backup oscillator;

- * deficiencies in systems engineering/flight rules;
- * too much reliance placed on the heritage of spacecraft hardware, software and procedures for near-Earth missions, which were fundamentally different from the interplanetary Mars Observer mission; and
- * the use of a firm fixed-price contract restricted the cost-effective and timely development of the unique and highly specialized Mars Observer Spacecraft.

Dr. Coffey notes, "We were challenged to conduct an extraordinarily complex investigation in which we had no hard evidence to examine nor communications with the spacecraft. However, after an extensive analysis covering every facet of the mission, operations and hardware, I believe that we are justified in arriving at the conclusions we have. If our findings will help to ensure that future missions won't suffer a similar fate, we feel we will have achieved our purpose."

Dr. Coffey also expressed his appreciation for the support provided to the investigation board by the six technical teams, other NRL and Air Force Phillips Laboratory contributors, NASA representatives, the JPL Project Team and Investigation Board, and the Martin Marietta Astro Space technical teams.

"I commend Dr. Coffey and his team for the thoughtful and thorough research into the tragic loss of the Mars Observer," said Dr. Wesley Huntress, Jr., Associate Administrator for NASA's Office of Space Science, Washington, D.C. "Their work will help and guide us in formulating a corrective action plan to help ensure future success as we plan for recovering our Mars science exploration objectives."

- end -

EDITOR'S NOTE: The Mars Observer Investigation Board Report is available to news media representatives by calling the NASA Headquarters Newsroom at 202/358-1600

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Headquarters, Washington, D.C.
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For Release
January 5, 1994

Don Nolan
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RELEASE: 94-2

NASA DEVELOPS ENHANCED RUNWAY VIEWS FOR SUPERSONIC PILOTS

NASA is testing a new optical system that would let pilots see the runway during nose-high landings without relying on complex mechanical structures or computer-generated views.

The Research External Vision Display (REVD) is a system of lenses and mirrors that reflects the view of the runway under the nose of the aircraft to a pilot in the cockpit. It does not need electronics or video cameras and has no moving parts. NASA started flight tests of the device on Dec. 23, 1993, using a modified F-104 aircraft at Ames-Dryden Flight Research Facility, Edwards, Calif.

"Pilots of supersonic aircraft usually land at a high angle-of-attack to maintain the descent rate at low speeds. This may block runway visibility at a crucial time during landing," said NASA project pilot Steve Ishmael. "The REVD system, which is basically an upside-down periscope, could be an effective solution."

The project will collect data to see how suitable such a system is to land an aircraft. Up to 20 flights are planned in the current test schedule. The program is slated to conclude by the end of January.

An REVD-like system could help pilots of a future U.S. supersonic airliner see the runway during the landing approach. The concepts for such a plane have a long, pointed nose that rules out forward-looking windows.

The European Concorde and Russian Tu-144 supersonic transports attack the problem by dropping the entire nose in front of the windshield. This approach works, but the mechanism that moves the nose is heavy, complex and expensive.

Another option is to equip a supersonic aircraft with video cameras or have an onboard computer create a "synthetic" view of the runway based on input from different types of sensors.

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But the electronic components in cameras and computers are not as durable as a simple mirror system, and video cameras have only one-hundredth the resolution of the human eye.

Future hypersonic aircraft, which would fly at more than five times the speed of sound, are expected to have similar problems with forward visibility. Even heat-resistant glass, if developed, could be damaged by impacts of raindrops or dust particles.

Installation of the device on the two-seat NASA F-104 requires a fairing extending from the fuselage just below the cockpit. The fairing houses the lower part of the REVD system, which looks out from beneath the aircraft and reflects the view up to the pilot in the rear cockpit.

Future designs may eliminate the fairing, which protrudes into the airstream. This could be done by recessing the REVD into the fuselage or by designing a retractable device that would drop down during landings.

The NASA-Dryden Project Manager is Roy Bryant. The project is a joint effort of Dryden; NASA's Ames Research Center, Mountain View, Calif.; the National Aero-Space Plane Joint Program Office at Wright-Patterson Air Force Base, Ohio; Lockheed Forth Worth Company, Texas; Kaiser Optical Electronics, Carlsbad, Calif.; and Systems Technologies Inc., Mountain View, Calif.

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NOTE TO EDITORS: Photos and video to accompany this release are available to media representatives by calling the Dryden Public Affairs Office, 805/258-3447.



For Release

Jeff Vincent
Headquarters, Washington, D.C.
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January 6, 1994

RELEASE: 94-3

NASA ADMINISTRATOR ANNOUNCES MANAGEMENT CHANGES

NASA Administrator Daniel S. Goldin announced today a number of management appointments and organization structural changes at NASA Headquarters in Washington, DC and at various NASA field centers.

"These appointments and realignments will enhance and strengthen the agency's programs and institutions," Goldin said. "They will affect NASA science, technology, research facilities and major programs, as well as the agency's Advisory Committee structure. All will benefit.

"The appointments and the emphasis they bring to their respective areas of expertise are in keeping with the President's goal to make government less expensive and more efficient, and to reinvigorate NASA."

NEW CENTER DIRECTORS

Ames Research Center

Dr. Ken K. Munechika has been appointed Director of the Ames Research Center, Mountain View, Calif. He has been serving as the Executive Director of the Office of Space Industry of the State of Hawaii. He previously held a number of key management and technical positions during a distinguished 31-year Air Force career. His last Air Force assignment was as Senior Commander of the Onizuka Air Force Base, Sunnyvale, Calif.

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Dr. Dale Compton, the present director of Ames, plans to retire on Jan. 28. Goldin said that Compton will be working with Munechika to affect a smooth transition. "The Ames Research Center will continue to play a major role in aeronautics becoming, along with the Langley Research Center, a Center of Excellence for Aeronautics," Goldin said. "These centers will provide an essential function supporting the U.S. aeronautics industry in maintaining a competitive edge and an advanced and far-reaching research capability."

Dryden Flight Research Facility

Effective March 1, 1994, the Dryden Flight Research Facility will be established as a separate entity, and will no longer be a part of the Ames Research Center. Kenneth J. Szalai, who currently heads Dryden as a deputy director of Ames, has been appointed as the new director of Dryden, reporting directly to Wesley Harris, Associate Administrator for Aeronautics. Goldin said that Szalai "will develop a timely transition plan to reflect the establishment of Dryden as a separate entity with responsibility for all functions related to its management.

"Operating as a separate facility, Dryden will be able to support the agency's aeronautics and space programs in a streamlined manner, by working directly to serve each of the research and flight centers," Goldin said. He said that Dryden will work with the centers and aerospace community customers to formulate and implement flight research and test programs and streamline program execution. Project reporting lines will directly link the centers and the NASA Headquarters offices that Dryden supports.

"This change reflects the commitment on the part of NASA to reduce layers of management and empower operating organizations to carry out their mission with maximum benefit to the country. It fully supports the fundamental principles to 'reinvent government,' the Administrator said.

Johnson Space Center

Dr. Carolyn Huntoon has been appointed Director of the Johnson Space Center, Houston, Tex. She has served as the Director of Space and Life Sciences at the Johnson Space Center since 1987. Previously she was the Associate Director of the center, assisting the Director and Deputy Director in its management.

Huntoon joined the Johnson Space Center in 1970 as a Senior Research Physiologist and was responsible for conducting research programs in the area of medical endocrinology and biochemistry. She is a pioneer in human life science research, having created and supervised projects in the Apollo, Skylab, Apollo-Soyuz, and Space Shuttle programs. She is the author of numerous technical papers and a fellow of the Aerospace Medical Association and the American Astronautical Society.

Huntoon is a recipient of the Arthur S. Fleming Award, the National Civil Service League Career Achievement Award for her work as a federal civil servant and numerous other awards. She received her doctorate degree from Baylor University, College of Medicine, in 1968.

Marshall Space Flight Center

G.P. (Porter) Bridwell has been appointed Director of the Marshall Space Flight Center, Huntsville, Ala. The current Director, Thomas (Jack) J. Lee, will become the agency's Special Assistant for Access to Space.

Bridwell served most recently as Deputy Manager of the Space Station Redesign Team and as a leader of the U.S.-Russian Space Station feasibility study this past summer. He has had a distinguished career with NASA since 1962. He previously served as Manager of the Shuttle Projects Office where he directed the Space Shuttle project activities assigned to the Marshall Space Flight Center, including the Space Shuttle main engine, External Tank, Redesigned Solid Rocket Motor, Solid Rocket Booster, Advanced Solid Rocket Motor, related systems and test activities and activities at the Michoud Assembly Facility.

Bridwell managed the performance of the Marshall Space Flight Center and industry contractors in the planning, design, engineering, integration, development, production testing, delivery and operations of Space Shuttle elements furnished to the center, ensuring that cost, schedule and performance goals were met. "Under Mr. Bridwell's direction," Goldin said, "Marshall's major role will be as the Center of Excellence for propulsion and providing access to space for the nation. The restoration of an active and vital launch capability is essential to the nation's future activities in space."

Lewis Research Center

Donald J. Campbell has been appointed Director of the Lewis Research Center, Cleveland, Oh. Campbell currently serves as Director of Science and Technology in the Office of the Assistant Secretary of the Air Force for Acquisition, Washington, D.C., an appointment he has held since April, 1992. He was responsible for monitoring the Air Force science and technology program, and other selected research, development, technology and engineering programs.

Campbell earned a bachelor's degree in mechanical engineering from Ohio Northern University in 1959 and a master's degree in the same subject in 1974 from Ohio State University. He has completed several management courses at the Brookings Institution. He began his government career in July, 1960 as a test engineer for gas turbine engines and engine components in the Air Force Aero Propulsion Laboratory, Wright-Patterson Air Force Base, Dayton, Oh. He worked as a project engineer and later as a program manager for advanced air breathing propulsion systems.

Campbell has extensive experience in large and small aircraft propulsion systems, ramjet engines, aerospace power systems and fuels and lubricants. He was appointed Director of the Aero Propulsion and Power Laboratory, Wright-Patterson Air Force Base, in January, 1990. He served as the senior civilian executive of the laboratory, responsible for power and propulsion research and development technology activities for future Air Force systems. Campbell was the first civilian director of aeronautics propulsion and power technology since 1928, and only the second civilian to serve in that capacity. He is a native of Ohio.

"Under Mr. Campbell's direction, the Lewis Research Center will fulfill a vital need as the nation's Center of Excellence for advanced air breathing propulsion systems in support of America's Aeronautics industry." Goldin said.

KEY APPOINTMENTS AT NASA HEADQUARTERS

Associate Deputy Administrator (Technical)

Michael I. Mott has been appointed Associate Deputy Administrator (Technical). He will report to the Administrator and provide independent technical analyses in the conceptual and formulative stages of programs. In addition, he will support on-going reviews of major programmatic and institutional issues.

Mott previously served as the Director for New Initiatives and Concept Development for General Research Corporation. He has served on numerous NASA civil space panels and review groups. These include the Hubble Space Telescope Servicing and Repair Mission Review Group, the Space Station Redesign Team, the NASA Administrator's Vision Panel, the Tethered Satellite System Prelaunch Review Group and the Mission Review Group for Satellite Rescue, Servicing and Repair.

Mott served with distinction in the United States Marine Corps. Following graduation from the U.S. Naval Test Pilot School, he was assigned as a test project officer at the Naval Air Test Center, participating and flying in 89 major test projects. He also served as the Deputy Director of the Technical Support Group for the Deputy Chief of Naval Operations (Naval Warfare), the Director of the Aviation Development Tactics and Evaluation Department at Marine Aviation Weapons and Tactics Squadron-One and as a panel member of the Naval Research Advisory Committee. A native of Nashville, Tenn., Mott is a graduate of Vanderbilt University and holds a master of science degree from the University of Southern California.

Special Assistant for Access to Space

Thomas (Jack) J. Lee has been appointed Special Assistant for Access to Space. Making the appointment, Goldin said that Lee "will be responsible for leading NASA efforts to help define a technology program for the future that will help the United States retain its leadership in space. This technology is critical to ensuring the retention of the nation's continuing access to space." Goldin said that with his experience as Marshall Space Flight Center director, Lee "brings the leadership and skills that are so essential to this position."

Associate Administrator for Mission to Planet Earth

Dr. Charles F. Kennel, from the University of California at Los Angeles, has been appointed as the Associate Administrator for Mission to Planet Earth. Kennel has a long and distinguished career in space science. He received an A.B. from Harvard College in 1959, and a Ph.D. in Astrophysical Sciences from Princeton University in 1964. He has been a tenured member of the UCLA Department of Physics since 1967, and was its chairman from 1983 to 1986. He became a member of UCLA's Institute of Geophysics and Planetary Physics in 1971, and is an Associate Director of UCLA's Institute for Plasma Physics and Fusion Research.

Kennel has been a Fulbright scholar, a Guggenheim scholar, and a Fairchild Professor at the California Institute of Technology. He is a fellow of the American Geophysical Union, the American Physical Society, and the American Association for the Advancement of Science, and a member of the International Academy of Astronautics and the U.S. National Academy of Sciences.

Chief Scientist for Mission to Planet Earth

Dr. Mark Abbott has been named Chief Scientist of the Office of Mission to Planet Earth. Abbott has been serving as a Professor of the College of Oceanic and Atmospheric Sciences at Oregon State University. Abbott has played an active role in the Earth Observing System since 1989. He has served in the College of Oceanographic and Atmospheric Sciences since 1988, at The Scripps Institute of Oceanography and earlier as a member of the Oceanographic Group at the Jet Propulsion Laboratory, Pasadena, Calif.

Director, Wind Tunnel Program Office

Lawrence J. Ross, formerly Director of the Lewis Research Center, has been appointed as the Director of the Wind Tunnel Program Office, reporting to the Office of the Administrator. Goldin said that NASA's test facilities are "critical to the country's aeronautics research program and the retention of America's leadership in aeronautics. The aeronautics industry accounts for a million high quality jobs throughout the United States." Ross, he said, "will be responsible for laying out a bold and innovative facility program to support the research needed for the next two decades."

SPACE STATION PROGRAM ANNOUNCEMENTS

Noting that the Space Station Program has been expanded to include Phase I Shuttle-Mir missions, Phase II United States-Russian activities and the Phase III International Space Station, the Administrator announced several key appointments in the program.

Deputy Associate Administrator for Space Station

Wilbur C. Trafton has been appointed Deputy Associate Administrator for Space Station. Prior to joining NASA, he was president of Micro Research Industries, a computer systems integration and software development company in Alexandria, VA.

Trafton retired as a Captain from the United States Navy in October, 1992 and last served as the Assistant Chief of Staff for Plans and Policy, U.S. Pacific Fleet. In this position he coordinated international military and diplomatic negotiations with Pacific Rim nations, including Russia. He planned and managed the withdrawal of all U.S. Naval forces from the Philippines. Trafton has held a number of other key command and management positions in the Navy and with the Department of Defense.

Born in Tela, Honduras, he holds a master of science degree from the U.S. Naval Postgraduate School.

Space Station Program Manager

Goldin said that the increase in the responsibilities of the Deputy Associate Administrator for Space Station has required a corresponding increase in the duties of the Program Office at the Johnson Space Center.

As a result, Randy Brinkley has been assigned as the Space Station Program Manager, with the responsibilities for management of all United States-Russian activities. He will be charged with working with Russia in implementing the United States-Russian activities for Phase I and Phase II, and working with international partners and Russia "to ensure implementation of the International Space Station," Goldin said. Brinkley was mission director for the recent Hubble Space Telescope Servicing Mission (STS-61).

Manager of Technical Activities

Captain William Shepherd, USN, will continue in his current capacity as the manager for all technical activities related to the International Space Station, reporting to Brinkley. "This management structure will enable Captain Shepherd to focus his expertise on the continued design, development, and assembly of the Space Station," the Administrator said.

Deputy Program Manager for Business

Daniel C. Tam has been assigned as the Deputy Program Manager for Business in the Space Station Program Office at the Johnson Space Center. Serving in this capacity he will be responsible for all the business management operations for the Space Station Program.

Tam has spent practically all of his professional career at TRW. He received a bachelor of science degree in mechanical engineering, and a masters degree in economics from the University of California at Davis and a Masters degree in business administration from UCLA. Since starting at TRW in 1975, Tam has held a number of key management positions. In January, 1993 Tam was named as the Manager of Acquisitions for the Space and Technology Group and was responsible for subcontracts, purchasing, proposal operations, facilities contracts, procurement review and system support, as well as the Small and Disadvantaged Business Office in the Space and Electronics Group.

NEW LEADERSHIP FOR NASA ADVISORY COUNCIL

Dr. Bradford W. Parkinson has been appointed head of the NASA Advisory Council. Parkinson was the original Program Director of the Defense Department's Global Positioning Satellite System. He has a broad background in guidance, control, astrodynamics, simulation, avionics, navigation and software engineering. He is currently a Professor of Aeronautics and Astronautics at Stanford University. Dr. Parkinson is also leading a Stanford research group that is developing innovative uses of the Global Positioning Satellite for aviation applications.

Parkinson received his Ph.D. in aeronautics and astronautics from Massachusetts Institute of Technology and Stanford. He was elected to the National Academy of Engineering and is a Fellow of the Royal Institute of Navigation and the American Institute of Aeronautics and Astronautics. He was awarded the Royal Institute of Navigation's Gold Medal and has received the Kirschner Award from the Institute of Electrical and Electronic Engineers. Parkinson has authored more than 50 papers on the subjects of guidance, navigation, and control.

The Advisory Council and its related committees provide advice and counsel to the Administrator on NASA's programs and policies. Parkinson has most recently served as a member of the Advisory Committee on the Redesign of the Space Station and the Hubble Space Telescope Review Committee.

Anne L. Accola has been appointed Staff Director of the NASA Advisory Council. Accola received a bachelor of science degree from Colorado State University and a master of science degree in computer science from the University of Wisconsin. She has extensive experience in NASA, serving in a number of key technical and management positions since joining NASA in 1967.

- 9 -

"I am extremely pleased with the quality of these appointments," said Goldin. "Their willingness to serve clearly shows that outstanding scientists, engineers, and managers, as in the early days of our Nation's space program, are willing to join NASA to help ensure America's leadership in space and aeronautics, and to help NASA return to the future."

- end -



Brian Dunbar
Headquarters, Washington, D.C.
(Phone: 202/358-1547)

For Release **Jan. 7, 1994**

Allen Kenitzer
Goddard Space Flight Center, Greenbelt, Md.
(Phone: 301/286-8955)

RELEASE: C94-b

NASA SELECTS INTERMETRICS TO NEGOTIATE EOSDIS CONTRACT

NASA has selected Intermetrics, Inc., McLean, Va., to negotiate a cost-plus-award-fee contract to provide Independent Verification & Validation (IV&V) of the Earth Observing System (EOS) Data and Information System (EOSDIS) for the Goddard Space Flight Center, (GSFC) Greenbelt, Md.. The estimated contract amount is \$81 million.

This contract will directly support NASA's EOSDIS, which is a key element in the EOS program, a part of NASA's Mission to Planet Earth. EOS will generate about 1 trillion bytes of new data per day which will be managed by EOSDIS, one of the most complex information systems ever built. It will enable quick and easy access to data about the Earth's ecosystem by the science research community.

The contract provides support service for the EOSDIS IV&V and key ground system interfaces and is expected to become effective on or about March 1994 and run through March 2004. The work will be done at NASA's IV&V facility, Fairmont, W.Va., and at the GSFC.

EOS and other satellite data, complemented by aircraft and ground data, will allow scientists to better understand natural environmental changes and to distinguish natural from human-made changes.

- end -

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 453-8400



Ed Campion
Headquarters, Washington, D.C.
(Phone: 202/358-1778)

For Release

January 10, 1994
3 p.m. EST

Kyle Herring
Johnson Space Center, Houston
(Phone: 713/483-5111)

RELEASE: 94-4

ASTRONAUTS SELECTED FOR ATLANTIS' STS-66 MISSION

Air Force Lieutenant Colonel Donald R. McMonagle has been selected to command Space Shuttle Mission STS-66 aboard Atlantis in the Fall of 1994. The mission, called ATLAS-03, will continue the series of Spacelab flights to study the energy of the sun and how it affects the Earth's climate and environment.

The remaining crew members for the third Atmospheric Laboratory for Applications and Science mission include USAF Major Curtis L. Brown, Jr., Pilot; mission specialist Scott E. Parazynski, M.D.; mission specialist Joseph R. Tanner and mission specialist Jean-Francois Clervoy, European Space Agency astronaut. Ellen Ochoa, Ph.D., earlier was named Payload Commander for the flight.

In addition to the ATLAS-03 investigations, the mission will include deployment and retrieval of the Cryogenic Infrared Spectrometer Telescope for Atmosphere, or CRISTA. Mounted on the Shuttle Pallet Satellite, the payload is designed to explore the variability of the atmosphere and provide measurements that will complement those obtained by the Upper Atmosphere Research Satellite launched aboard Discovery in 1991. CRISTA-SPAS is a joint U.S./German experiment.

McMonagle, 41, flew as a mission specialist aboard Discovery's STS-39 mission in April/May 1991. He also was pilot on the crew of STS-54 in January 1993. Born in Flint, Mich., McMonagle received a bachelor of science degree in astronautical engineering from the U.S. Air Force Academy in 1974 and a master of science degree in mechanical engineering from California State University-Fresno in 1985.

- more -

Brown, 37, served as the Pilot aboard Endeavour on Mission STS-47, Spacelab-J, in September 1992. Brown was born in Elizabethtown, N.C., and received a bachelor of science degree in electrical engineering from the Air Force Academy in 1971.

Parazynski, 32, was born in Little Rock, Ark., but considers Palo Alto, Calif., and Evergreen, Colo., to be his hometowns. Parazynski received his doctorate in medicine from Stanford Medical School in 1989. Parazynski was selected for the astronaut corps in March 1992. STS-66 will be his first Space Shuttle mission.

Tanner, 43, was born in Danville, Ill., and received his bachelor of science degree in mechanical engineering from the University of Illinois in 1973. He has been with NASA since 1984, serving as an aerospace engineer and research pilot. Tanner instructed astronaut pilots in Shuttle landing techniques aboard the Shuttle Training Aircraft and served as aviation safety officer. Prior to being selected to the astronaut corps as a member of the class of 1992, Tanner was the Deputy Chief of the Aircraft Operations Division at the Johnson Space Center, Houston. He will be making his first Space Shuttle flight.

Clervoy, 35, was born in Longeville-le-Metz, France, but considers Toulouse, to be his hometown. He received his bachelors degree from the College Militaire de Saint Cyr l' Ecole in 1976 and graduated in 1987 from the Ecole du Personnel Navigant d' Essais et de Reception, Istres, as a flight test engineer. In August 1992, Clervoy reported to the Johnson Space Center as part of the astronaut class of 1992. STS-66 will be his first Space Shuttle mission.



Ed Campion
Headquarters, Washington, D.C.
(Phone: 202/358-1778)

For Release

January 10, 1994
3 p.m. EST

Kyle Herring
Johnson Space Center, Houston
(Phone: 713/483-5111)

RELEASE: 94-5

CREW SELECTED FOR STS-67 ASTRONOMY MISSION

Veteran astronaut Stephen S. Oswald will command the STS-67 flight, an astronomy mission aboard Space Shuttle Columbia in late 1994. The mission objectives are to study the far ultraviolet spectra of faint astronomical objects and to study the polarization of ultraviolet light coming from hot stars and galaxies.

Joining Oswald on the mission are Air Force Major William G. Gregory, who will serve as the Pilot; Navy Lieutenant Commander Wendy B. Lawrence, mission specialist; and payload specialists Ronald A. Parise and Samuel T. Durrance. They will join Payload Commander Tamara E. Jernigan, named to the crew in August 1993, and mission specialist John M. Grunsfeld, named in October 1993.

The Astro-2 mission is the second dedicated to the conduct of astronomical observations in the ultraviolet spectral regions. The experiments will observe a variety of targets ranging from objects inside the solar system to individual stars, nebulae, supernova remnants, galaxies and active extragalactic objects. The first Astro mission was flown in December 1990 aboard Columbia.

Oswald, 42, was Pilot on two missions aboard Discovery, STS-42 and STS-56 flown in January 1992 and April 1993, respectively. He was born in Seattle, Wash., but considers Bellingham, Wash., his hometown. Oswald received a bachelor of science degree in aerospace engineering from the U.S. Naval Academy in 1973.

- more -

Gregory, 36, was born in Lockport, N.Y., and received a master of science degree in engineering mechanics from Columbia University in 1980 and a master of science degree in Management from Troy State in 1984. Gregory was selected for the astronaut corps in 1990. STS-67 will be his first Space Shuttle mission.

Lawrence, 34, was born in Jacksonville, Fla., and received a bachelor of science degree in ocean engineering from the U.S. Naval Academy in 1981. Her 1988 master of science degree in ocean engineering is from the Massachusetts Institute of Technology. Lawrence is a member of the astronaut class of 1992. This will be her first Space Shuttle mission.

Parise, 42, was born in Warren, Ohio, and received a doctor of philosophy degree in astronomy from the University of Florida in 1979. Parise is a member of the research team for the Ultraviolet Imaging Telescope, one of the instruments scheduled for flight as part of the Astro payload. STS-67 will be his second flight as a payload specialist having served in that capacity on the first Astronomy payload mission aboard Columbia on the STS-35 flight in December 1990.

Durrance, 50, was born in Tallahassee, Fla., but considers Tampa, to be his hometown. He received a doctor of philosophy degree in astrophysics from the University of Colorado in 1980. Durrance is a Research Scientist in the Department of Physics and Astronomy at Johns Hopkins University, Baltimore, Md. He is Assistant Project Scientist for the Hopkins Ultraviolet Telescope, one of the instruments scheduled to fly as part of the Astro Observatory. Durrance is making his second flight as a payload specialist. He also served as a payload specialist on Columbia's Astro-1 mission, STS-35, in December 1990.

Sarah Keegan
Headquarters, Washington, D.C.
(Phone: 202/358-1547)

For Release

January 11, 1994

Jim Elliott
Goddard Space Flight Center, Greenbelt, Md.
(Phone: 301/286-6256)

EDITORS NOTE: N94-4

HUBBLE SPACE TELESCOPE NEW IMAGES MEDIA BRIEFING SET

NASA Administrator Daniel S. Goldin and U.S. Senator Barbara A. Mikulski, Chair, Subcommittee on VA, HUD and Independent Agencies, will release new Hubble Space Telescope images at a press conference on Thursday, Jan. 13, at 10:30 a.m. EST at the Goddard Space Flight Center (GSFC) Visitor Center auditorium, Greenbelt, Md.

Following Goldin's and Mikulski's remarks, HST science team members and spacecraft managers will discuss the images and the status of the spacecraft hardware and systems.

The press conference will be carried live on NASA Select television -- Spacenet 2, Transponder 5, 69 Degrees West Longitude, horizontal polarization, frequency 3880.0 Megahertz and audio 6.8 Megahertz. Following the press conference, all video used during the conference will be replayed.

Media representatives should contact Michelle Mangum at 301/286-8956 for directions to the GSFC Visitor Center.

- end -

For Release

Ed Campion
Headquarters, Washington, D.C.
(Phone: 202/358-1780)

January 11, 1994

Brian Welch
Johnson Space Center, Houston
(Phone: 713/483-5111)

RELEASE: 94-6

ABBEY NAMED JSC DEPUTY DIRECTOR; WEITZ TO RETIRE IN APRIL

George W.S. Abbey was named Deputy Director of the Johnson Space Center (JSC), Houston, today by the new center Director Dr. Carolyn L. Huntoon.

Abbey succeeds Paul J. "P.J." Weitz, who will serve as the Acting Associate Director during the transition of the new center management team until his planned retirement in April. Weitz has served as the center's Deputy Director since 1987 and Acting Director since the retirement of Aaron Cohen in August 1993.

"I am pleased to welcome George Abbey back to JSC in a role that will capitalize on his unique experience and organizational skills," Huntoon said. "With the upcoming retirement of P.J. Weitz, George has large shoes to fill, but he brings a wealth of expertise to the job, and his insights will be invaluable as the JSC team meets the challenges ahead of us in the 1990s."

Abbey is a 1954 graduate of the U.S. Naval Academy who went on to become a U.S. Air Force pilot in the late 1950s. While serving as an Air Force officer from 1959 to 1964, he was involved in the Air Force DYNASOAR program. He was detailed to the Johnson Space Center (then the Manned Spacecraft Center) in 1964 and resigned his commission to become a member of the civil service staff in 1967. In January of that year, he became technical assistant to Apollo Program Manager George M. Low.

-more-

In 1969, Abbey became technical assistant to Robert Gilruth, the Director of the Manned Spacecraft Center. In 1976, he became Director of Flight Operations, responsible for planning and overall direction of flight crews and flight control activities for all U.S. human space flights. In a 1985 reorganization, Abbey became Director of the newly formed Flight Crew Operations Directorate, responsible for management and direction of flight crews as well as the center's fleet of aircraft.

In 1988, Abbey was named Deputy Associate Administrator for Space Flight, NASA Headquarters, Washington, D.C. He most recently served as Special Assistant to NASA Administrator Daniel S. Goldin.

Weitz, who plans to retire in April 1994, will serve as Acting Associate Director of JSC until his retirement. He has been a NASA astronaut since 1966 and has logged a total of 793 hours in space on two space flights. Weitz received his commission as an ensign in the U.S. Navy through the Naval ROTC program at Pennsylvania State University before earning his pilot wings in 1956. He served in various naval squadrons until he was selected as an astronaut in 1966. He has logged more than 7,700 hours flying time, with 6,400 hours in jet aircraft.

Weitz, one of 19 astronauts selected in the class of 1966, served as pilot on the crew of Skylab-2 from May 25 to June 22, 1973. Skylab-2 was the first flight of astronauts to the orbital workshop, and the crew logged 672 hours and 49 minutes aloft, establishing what was then a new world record for a single space mission. During that flight, Weitz also logged 2 hours and 11 minutes of spacewalk time in a dramatic repair of mechanisms that had been damaged during the launch of Skylab on May 14, 1973.

His second space flight was as the Commander of STS-6, the maiden voyage of the Space Shuttle Challenger in April 1983. During the mission, the crew deployed the first Tracking and Data Relay Satellite, conducted the first spacewalk of the Shuttle era and performed numerous experiments in materials processing. The mission duration was 120 hours.

Weitz has been awarded the NASA Distinguished Service Medal, the Navy Distinguished Service Medal, the Robert J. Collier Trophy for 1973, the Robert H. Goddard Memorial Trophy for 1975 and the NASA Space Flight Medal.

NASA News

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Washington, D.C. 20546
AC 202 453-8400



Ed Campion
Headquarters, Washington, D.C.
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For Release
January 12, 1994

Brian Welch
Johnson Space Center, Houston
(Phone: 713/483-5111)

NOTE TO EDITORS: N94-5

SPACE SHUTTLE MISSION STS-60 PRE-FLIGHT BRIEFINGS SCHEDULED

Pre-flight briefings for the next Space Shuttle mission, STS-60 aboard Discovery, are scheduled for Jan. 19 at the Johnson Space Center, Houston.

The 18th mission of Discovery, scheduled for launch from the Kennedy Space Center, Fla., Feb. 3, will feature the deployment and retrieval of the Wake Shield Facility; the second flight of the Spacehab module; and the first flight of a Russian cosmonaut aboard a Space Shuttle.

The briefings will include a mission overview by the lead flight director beginning at 9 a.m. EST; a discussion of U.S. and Russian cooperation in space from 10 to 10:45 a.m. EST; an overview of the Wake Shield Facility from 10:45 to 11:30 a.m. EST; and a briefing on the Spacehab module and the experiments for this flight, to be held from 11:30 a.m. to 12:15 p.m. EST. At 1 p.m. EST, the six-person STS-60 crew will discuss their mission in a 1-hour press conference. As time permits, the crew will be available for brief one-on-one interviews following their conference. News media interested in the one-on-one interviews should contact the JSC newsroom before close of business Jan. 14.

All briefings will be carried on NASA Select television with two-way audio capability. NASA Select programming is carried on Spacenet 2, transponder 5 with a frequency of 3880 MHz, audio 6.8 MHz. The satellite is located at 69 degrees West longitude.

-end-

Brian Dunbar
Headquarters, Washington, D.C.
(Phone: 202/358-1547)

For Release

January 13, 1994

Franklin O'Donnell
Jet Propulsion Laboratory, Pasadena, Calif.
(Phone: 818/354-5011)

RELEASE: C94-c

NASA, CALTECH SIGN JPL MANAGEMENT CONTRACT

NASA and the California Institute of Technology have signed a new 5-year contract for management of NASA's Jet Propulsion Laboratory (JPL), a federally funded research and development center in Pasadena, Calif.

The cost-plus-award-fee contract, which has a value of \$5 billion, consolidates two previous contracts, one for research and development and one for facilities.

JPL, NASA's lead installation for solar system exploration, designed and built the new Wide Field/Planetary Camera (WF/PC II) that recently was installed on NASA's Hubble Space Telescope. JPL also manages NASA's interplanetary programs, such as the Galileo mission to Jupiter, the Magellan mission to Venus and the U.S. portion of the NASA/ESA Ulysses mission to study the sun.

JPL also plays a role in NASA's Mission to Planet Earth, which is conducting long-term research into how the Earth's environment is changing. JPL manages the U.S. portion of TOPEX/POSEIDON, an oceanography mission being conducted with CNES, the French space agency. JPL also is the managing center for the U.S. portion of SIR-C/X-SAR, a radar system that will fly twice aboard the Space Shuttle in 1994 to study the Earth's environment.

Approximately 7,300 employees and contractors work at JPL's main facility near Pasadena, Calif., and at other locations. Caltech has managed JPL for NASA since the space agency's inception in 1958.

- end -

Sarah Keegan
Headquarters, Washington, D.C.
(Phone: 202/358-1547)

For Release

January 13, 1994

Jim Elliott
Goddard Space Flight Center, Greenbelt, Md.
(Phone: 301/286-6256)

RELEASE: 94-7

NASA DECLARES HUBBLE SERVICING MISSION SUCCESSFUL

NASA Administrator Daniel S. Goldin today declared that last month's Space Shuttle mission to service the Hubble Space Telescope (HST) had been fully successful in correcting the vision of the telescope's optical components. The announcement, accompanied by the first new images from HST, followed the initial 5 weeks of engineering check-out, optical alignment and instrument calibration.

Word of the Hubble success came at a press conference at NASA's Goddard Space Flight Center, Greenbelt, Md. Goldin was joined in making the initial announcement by Dr. John H. Gibbons, Assistant to the President for Science and Technology, and Senator Barbara A. Mikulski (Md.), Chair, Appropriations Subcommittee on VA, HUD and Independent Agencies.

"This is phase two of a fabulous, two-part success story," Goldin said. "The world watched in wonder last month as the astronauts performed an unprecedented and incredibly smooth series of space walks. Now, we see the real fruits of their work and that of the entire NASA team.

"Men and women all across this agency committed themselves to this effort. They never wavered in their belief that the Hubble Space Telescope is a true international treasure," Goldin said.

Mikulski, who unveiled two new HST pictures at the press conference, said, "I am absolutely delighted that Hubble is fixed and can see better than ever. This is tremendous news.

- more -

- 2 -

"Now we are going to look at the origins of our universe, "Mikulski said. "What a wonderful victory this is for the Hubble team of astronauts, astronomers, scientists and engineers. Together they are moving American science and technology into the 21st century with exciting new opportunities for scientific and economic progress."

Pictures were released from the two cameras that received corrective optics during the servicing mission -- the Wide Field/Planetary Camera II and the European Space Agency's Faint Object Camera.

-end-

For Release

Terri Sindelar
Headquarters, Washington, D.C
(Phone: 202/358-1977)

January 13, 1994

RELEASE: 94-8

"MISSION EARTHBOUND" EDUCATIONAL TELECASTS SCHEDULED

This semester, students and teachers can take an electronic field trip to planet Earth to study its complex balance of atmosphere, oceans, chemistry and temperature -- a balance that has nurtured a diversity of life beginning with microbes 4.5 billion years ago to humans today.

This new, 6-part television series, called "Mission EarthBound, " also will explore issues related to how the human quest to advance technologically has developed processes capable of altering the global environment as well as the economic, social and political implications of these processes.

These live, 1-hour, entertaining and educational episodes will feature Dr. Joel Levine, a senior atmospheric scientist at NASA's Langley Research Center, Hampton, Va., who will offer viewers insights into global change issues. Also featured will be William Orton, a teacher from Virginia, who has assembled atmospheric information into an educator's context.

Series dates and topics for the 2-3 p.m. ET live broadcasts are:

Jan. 14	Mission EarthBound
Jan. 28	The Earth's Atmosphere--A Cosmic Perspective
Feb. 25	Atmospheric Ozone--What is it and What is Happening to it?
March 25	Greenhouse Gases and Climate Change
April 29	The Climate System and Climate Modeling
May 27	Challenges and Solutions to Global Atmospheric Change

Viewers of Mission EarthBound will have the opportunity to call and fax questions during the live broadcasts and post E-mail questions on an Internet mailbox from January through June.

- more -

An accompanying Mission EarthBound Teachers Guide has been produced and includes a science abstract for each episode, lab activities and thinking log assignments to complement the program. To obtain a copy contact Old Dominion University, 101 Hughes Hall, Norfolk, Va., 23529, or call (804) 683-5173.

Viewers across the nation can tune-in to Mission EarthBound through several distance learning networks and television stations. Participating broadcasters have agreed to deliver live or tape-delayed programs or inform their viewership of satellite coordinates for the 6-part series. These broadcasters are:

Fairfax Network (Fairfax, Va.)
HEB Satellite in the Classroom (275 schools in south and central Texas)
KET (1300 schools in Kentucky)
MCET (more than 1000 schools in northeastern U.S.)
MEU (25 million viewers nationally, via cable)
National Science Centers (Army VTC system)
SERC (500 schools in southeastern U.S.)
STEP (700 schools in northwestern U.S.)
TI-IN Network (1500 schools in 42 states)
VSEN (Virginia Secondary Schools)
WHCS (Hampton, Va.)
WHRO-PBS (Norfolk, Va.)

Additionally, NASA Select TV, the television service of the National Aeronautics and Space Administration, will carry the programs live. However, should a Space Shuttle mission or press event preempt the live broadcasts, NASA will tape and replay the episode at a later date. NASA Select is transmitted on Spacenet 2, transponder 5/channel 9, 69 degrees West with horizontal polarization, frequency 3880.0 MHz, audio on 6.8 MHz.

For technical or registration information, contact Old Dominion University, Academic Television Services, 101 Hughes Hall, Norfolk, Va., 23529 or call (804) 683-5173.

For additional information contact Camille Jennings, Education Office, NASA Langley Research Center, 17 Langley Blvd., Mail Stop 400, Hampton, Va., 23681; or call (804) 864-8770.

Mission EarthBound is produced by NASA's Langley Research Center, Old Dominion University Academic Television and the Virginia Space Grant Consortium. Funding was provided by NASA Headquarter's Education Division. This series discusses the ongoing research by NASA's multiyear, global study program called Mission to Planet Earth.

For Release

Dwayne C. Brown
Headquarters, Washington, D.C.
(Phone: 202/358-0547)

January 14, 1994

RELEASE: 94-9

BROOKS APPOINTED SPACE COMMUNICATIONS DEPUTY AA

NASA Administrator Daniel Goldin announced today the appointment of Brigadier General Elmer T. Brooks, USAF (Retired), as the Deputy Associate Administrator for NASA's Office of Space Communications (OSC), NASA Headquarters, Washington, D.C., effective Jan. 18, 1994.

"Elmer Brooks brings to this position a very strong background in both management and technical matters," Goldin said. "I am extremely pleased to be able to select someone of his caliber for this important assignment."

"Elmer's expertise will be invaluable for the many challenges our office faces utilizing new telecommunications technologies during a time of limited funding," said Charles Force, Associate Administrator for Space Communications.

The OSC is responsible for planning, development and operation of NASA's worldwide communications, telemetry and data acquisition activities essential to the success of all NASA flight programs.

Brooks attended Howard University, then received a BA in zoology and a commission in the Air Force via ROTC from Miami University, Ohio. He received a MS degree in Administration from George Washington University and later, completed the Industrial College of the Armed Forces and the Executive Program of Graduate School of Business at the University of Virginia.

In June 1985, Brooks retired from the U.S. Air Force after 30 years of service. During that time he held a variety of positions including the military assistant to two Secretaries of Defense; arms control policy-maker and advisor to the Joint Chiefs of Staff; Deputy Commissioner of the U.S./USSR Standing Consultative Commission; Assistant Deputy Under Secretary of Defense for Research and Engineering (nuclear and space systems) and commander of an Air Force base and major missile unit.

- more -

Brooks also was a flight control technologist for Gemini and Apollo missions at the Johnson Space Center, Houston, and Research and Development Personnel Manager at Headquarters, U.S. Air Force.

After leaving military service, Brooks became a consultant for high technology industry and then, general manager of a private investment banking firm in London.

He joined NASA in 1988, as Assistant for Special Projects, Office of the Administrator. He served as the Deputy Associate Administrator for Management in February 1989 and was appointed as the Deputy Associate Administrator (Agency Programs) For Management Systems And Facilities in October 1991. Brooks will succeed Jerry J. Fitts, who retired from NASA's OSC in early January.

Brooks, a native of Washington, D.C., is married to the former Kathryn Casselberry of Dayton, Ohio. They have a daughter and three sons and reside in Bethesda, Md.

- end -



Brian Dunbar
Headquarters, Washington, D.C.
(Phone: 202/358-0873)

For Release

January 15, 1994
Embargoed until 9:30 a.m.

Michael Finneran
Goddard Space Flight Center, Greenbelt, Md.
(Phone: 301/286-5565)

RELEASE: 94-10

SATELLITE FINDS IMPRINT OF UNIVERSE ON GAMMA-RAY EXPLOSIONS

Astronomers have uncovered new evidence that huge explosions, known as gamma-ray bursts, occurred in the far reaches of the universe and bear an imprint of the universe's expansion.

Analysis of data from NASA's Compton Gamma Ray Observatory satellite by a team led by Dr. Jay Norris of Goddard Space Flight Center, Greenbelt, Md., now indicates that gamma-ray bursts show relative "time-dilation." This is an effect that would be created by many of the bursts occurring so far away in the universe that time is seen to be running noticeably slower there.

Time dilation is a consequence of the General Theory of Relativity and the expansion of the universe. Thus, time intervals from very distant parts of the universe will be stretched as the gamma-ray bursts make their way across the expanse of space, which is itself expanding.

This much sought-after result provides additional evidence that gamma-ray bursts are not limited to the area of the Milky Way galaxy as some researchers have suggested.

"This is a great result, one of the most spectacular astrophysical discoveries of the decade," said Professor Bohdan Paczynski of Princeton University. Paczynski and Dr. Tsvi Piran of Harvard University and Hebrew University of Jerusalem had previously predicted the effect in gamma-ray bursts.

Norris was cautious about the meaning of time-dilation. "Our result should not be taken as proof that the time-dilation is a result of cosmological expansion of the universe -- just that a difference in durations of bright and dim bursts does exist and must now be accounted for by any theory," Norris said.

- more -

"If time-dilation is a result of cosmology," added Goddard-based Dr. Robert Nemiroff of George Mason University and a member of the Norris team, "then this is not only an important discovery about gamma-ray bursts, it is a discovery that gamma-ray bursts may be able to tell us about distant parts of our universe."

The Norris team, which includes astrophysicists at Goddard and NASA's Marshall Space Flight Center, Huntsville, Ala., NASA's Ames Research Center, Mountain View, Calif., and the University of Pennsylvania, uncovered gamma-ray burst time-dilation in two ways.

First, they showed that dim bursts typically have twice the duration of bright gamma-ray bursts. Next, they showed that dim bursts typically are "redder" in gamma-ray color than bright bursts, an effect that is a direct result of time-dilation on the gamma-ray burst spectrum.

Norris stressed that while the time-dilation effect itself is well quantified, the spectral difference, though very significant, is yet to be calibrated.

Bursts Outshine Entire Gamma-Ray "Sky"

Gamma-ray bursts are huge explosions that have been detected only in the gamma-ray region of the spectrum. Some last only a fraction of a second, but others are as long as a few minutes. A gamma-ray burst explosion dramatically outshines the entire sky in the gamma-ray band.

The origins of gamma-ray bursts have been an enigma since their discovery in the late 1960s by U.S. defense satellites. But the Compton Gamma Ray Observatory has allowed astronomers to study these bursts in more detail than ever. Until Compton's observations of hundreds of bursts, it was widely believed that the sources of these powerful phenomena were in the Milky Way galaxy.

The celestial distribution of gamma-ray bursts is uniform unlike the appearance of the Milky Way galaxy, which looks like a band in the sky. The fact that gamma-ray bursts come from all directions is what originally suggested a cosmological, or extra-galactic, origin, and so a search for time-dilation began.

If the time dilation measured by Norris's team is a good indication of gamma-ray burst distance, then these bursts are occurring far into the universe. In addition, for Compton to see them as bright as they are, the power of these explosions may be greater than anything ever seen before, as much as one quintillion suns.

The astronomical community is cautious about accepting this result blindly. "I like to think I'm objective," said Dr. Thomas Cline, a long-time gamma-ray burst researcher at Goddard, "and although the outcome of this analysis is consistent with the hoped-for time-dilation effect, I'm still concerned that it might result from a real but misleading feature of the changing luminosity of gamma-ray bursts or a misleading but unreal feature of the data or the satellite. That, of course, only heightens the mystery."

"We've found time-dilation using several statistical tests," said Norris, who then listed several detailed mathematical and statistical tests that were performed on the data. The spectral difference between bright and dim bursts, also seen in a statistical sense, was found by comparing the spectral "colors" of bursts across the durations of gamma-ray burst events.

Dr. Virginia Trimble of the University of Maryland and California, Irvine, said: "For more than 50 years, astronomers have been looking for objects or phenomena whose observed properties are dominated by the large scale evolution and structure of the universe ('cosmological effects') rather than by observational selection or the detailed evolution of the individual objects. If the gamma bursts have indeed revealed such cosmological effects, then this is perhaps even more important as an astrophysical 'first' than as a contribution to our understanding of the bursters themselves."

The Norris team analyzed data from Marshall's Burst and Transient Source Experiment (BATSE) on board Compton, whose principal investigator is Dr. Gerald Fishman. The Compton Gamma Ray Observatory, deployed from the Space Shuttle Atlantis on April 7, 1991, is managed by Goddard for the Office of Space Science at NASA Headquarters, Washington, D.C.

- end -

Editors Note: The subject of this release will be discussed at a press conference at the American Astronomical Society meeting on Saturday, Jan. 15, at 9:20 a.m. in the Alexandria Room of the Crystal Gateway Marriott, Arlington, Va.

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 453-8400



Charles Redmond
Headquarters, Washington, D.C.
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For Release
January 18, 1993

NOTE TO EDITORS: N94-6

TECHNOLOGY OFFICE TO HOLD FORUM FOR INDUSTRY

NASA's Office of Advanced Concepts and Technology (OACT) will hold a 1-day industry forum on Friday, Jan. 21, beginning at 8:30 a.m. EST in the NASA Headquarters Auditorium, 300 E St., S.W., Washington, D.C.

One of OACT's new programs for FY 94 is an Aerospace Industry Technology Program (AITP) which is designed to foster a continuing series of technology research and development projects between NASA and industry which will focus on high-risk, high-payoff technology development. Projects under this program will be funded equally between NASA and its industry partners.

To ensure that NASA remains responsive to industry's needs, the day-long forum will allow industry to have participation in all aspects and phases of the AITP program, including this early development stage. Industry representatives will be allowed to provide presentations on both program content and program structure.

The forum is set up with an opening plenary session, two successive sets of breakout sessions and a closing plenary session. The opening session will be carried on NASA Select television. The closing session will be videotaped for subsequent replay and videotape distribution through the AITP program office.

The program manager for AITP is John C. Mankins, OACT. The fiscal 1994 budget allocation for this technology initiative is \$20 million.

- end -

Brian Dunbar
NASA Headquarters
Washington, D.C. 20546
(phone: 202/358-1547)

For Release

January 24, 1994

Allen Kenitzer
Goddard Space Flight Center
Greenbelt, Md. 20771
(phone: 301/286-8955)

RELEASE: C94-d

NASA SELECTS SWALES TO NEGOTIATE \$275-MILLION CONTRACT

NASA has selected Swales and Associates, Inc., Beltsville, Md., to negotiate a cost-plus-award-fee contract to provide mechanical systems engineering development for the Goddard Space Flight Center, Greenbelt, Md. The estimated contract amount is \$274.9 million.

This contract will provide mechanical systems development in areas including mechanical design, structural analysis, contamination control studies, launch landing loads and stress analysis, optical design analysis and prototype and flight hardware fabrication and hardware assembly. This is in response to tasks initiated by the Mechanical Systems Division of the Goddard Engineering Directorate.

The contract is expected to become effective on April 1, 1994, and run through March 31, 2001. It will be the principal source of mechanical systems engineering development for Goddard flight projects such as the Lyman Far Ultraviolet Spectroscopic Explorer, X-Ray Timing Explorer and Earth Observing System-Chemistry and Tropical Rainfall Measuring Mission.

Swales is a "small business" and this procurement was set aside for small businesses only.

-end-

Barbara Selby
Headquarters, Washington, D.C.
(Phone: 202/358-1983)

For Release
January 21, 1994

Lori Rachul
Lewis Research Center, Cleveland
(Phone: 216/433-8806)

RELEASE: C94-e

NASA LEWIS AWARDS SUPPORT SERVICES CONTRACT

The NASA Lewis Research Center, Cleveland, has awarded Engineering Design Group, Inc., Tulsa, Okla., a contract for engineering, construction and environmental services to be performed at the Lewis Research Center and at the Plum Brook Station, Sandusky, Ohio.

The cost-plus-award-fee contract will have a phase-in period of approximately 1 month, a basic period of 2 years and three 1-year optional renewal periods. The base contract dollar amount is \$13.6 million. The total contract value is estimated to be \$45 million.

The contractor will perform a variety of engineering, construction and environmental services for rehabilitation, modification and construction of research and institutional facilities and systems.

Award of this contract to Engineering Design Group, Inc., a small business, requires that at least 20 percent of the total contract amount include the participation of small, disadvantaged businesses.

The Lewis Research Center is obligating approximately \$52 million in contracts to small, disadvantaged businesses from the estimated total obligations of \$655 million for fiscal year 1994.

- end -

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 453-8400



For Release

January 25, 1994

Jim Cast
Headquarters, Washington, D.C.
(Phone: 202/358-1779)

Barbara Schwartz
Johnson Space Center, Houston
(Phone: 713/483-5111)

RELEASE: C94-f

NASA SELECTS PIONEER CONTRACT SERVICES

NASA Johnson Space Center (JSC), Houston, has selected Pioneer Contract Services of Houston for contract negotiations to perform logistics support services at JSC. The approximate value of this cost-plus-award-fee contract is \$42 million for 5 years. The basic contract period beginning March 1, 1994, is for 2 years plus one 3-year option.

The logistics services for JSC will include identification, cataloging, receipt and inspection of property; warehouse operations for store stock; bondroom operations for program stock; transportation support services; packing and shipping, and redistribution and utilization of property.

-end-

NASA News

National Aeronautics and
Space Administration

- more -

Washington, D.C. 20546
AC 202 453-8400



Jim Cast
Headquarters, Washington, D.C.
(Phone: 202/358-1779)

For Release
January 26, 1994

Barry Epstein
Headquarters, Washington, D.C.
(Phone: 202/358-1181)

NOTE TO EDITORS: N94-7

NEW ERA OF DISCOVERY: PLANS FOR RESEARCH ON SPACE STATION

The NASA space station program plans to hold the first live videoconference to colleges, businesses and hospitals in cooperation with the Public Broadcasting Service Adult Learning Satellite Service (PBS ALSS). This 2-hour program, which will focus on space station research, is scheduled for Feb. 17, 1994, from 1 p.m. to 3 p.m. EST.

Space station is designed to provide a microgravity environment which will enable research in life sciences, materials, fluid physics, combustion and biotechnology research and technology development.

This videoconference is for anyone who wishes to learn about research plans, benefits and opportunities related to the space station. The general public is welcome to participate.

Any site having access to a satellite television receive Earth station may license to carry this program at no cost. If you wish to license a site or to find out the site nearest you which will be receiving the program, you can call PBS at 1-800/257-2578.

-end-

For Release

Ed Campion
Headquarters, Washington, D.C.
(Phone: 202/358-1778)

January 26, 1994

NOTE TO EDITORS: 94-8

STS-51 Anomaly Investigation Report Completed

The board appointed by Jeremiah Pearson, Associate Administrator for Space Flight, to study the cause of the anomaly experienced during Shuttle Mission STS-51 last September has completed its investigation.

During deployment of the ACTS communication satellite, commands intended to initiate a single explosive cord firing actually resulted in the simultaneous firing of both the primary and back up cord. This resulted in the rupture of a containment tube and release of debris into the cargo bay of Shuttle Discovery.

Dr. Robert Wingate of NASA's Langley Research Center, Hampton, Va., served as chairman of the investigation board. The final report, submitted by Dr. Wingate and his team, describes the primary and contributing causes for the anomaly and makes recommendations for corrective actions.

A copy of the report is available for review in the NASA Headquarters newsroom, Washington, D.C., and the newsrooms at the Kennedy Space Center, Fla; the Marshall Space Flight Center, Huntsville, Ala.; the Johnson Space Center, Houston; the Stennis Space Center, Bay St. Louis, Miss.; and the Dryden Flight Research Center, Edwards, Calif.

- end -

For Release

Jim Cast
Headquarters, Washington, D.C.
(Phone: 202/358-1779)

January 26, 1994

Bruce Buckingham
Kennedy Space Center, Fla.
(Phone: 407/867-2468)

NOTE TO EDITORS: N94-9

LAUNCH DATE FOR STS-60/DISCOVERY SET

Following today's STS-60 Flight Readiness Review at NASA's Kennedy Space Center, Fla., Shuttle managers targeted Feb. 3 for launch of the Space Shuttle Discovery on mission STS-60. The 2-1/2 hour launch window opens at 7:10 a.m EST.

Highlights of the 8-day flight will include experimentation inside the pressurized Spacehab module and the deployment and retrieval of a 12-foot diameter experiment platform called the Wake Shield Facility.

STS-60 represents the 60th flight of the Space Shuttle and the 18th for Discovery. The mission will be commanded by Charles Bolden and piloted by Ken Reightler. Rounding out the six-person crew will be 4 Mission Specialists: Jan Davis, Ron Sega, Franklin Chang-Diaz and the first Russian cosmonaut to fly aboard the Shuttle, Sergei Krikalev.

- end -

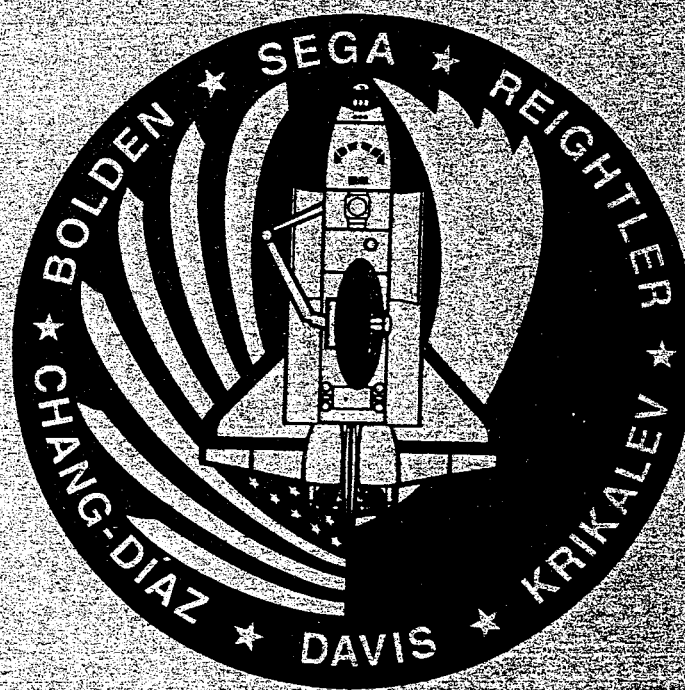
94-11

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SHUTTLE MISSION STS-60

PRESS KIT
FEBRUARY 1994

94-11



WAKE SHIELD FACILITY
SPACEHAB-2

STS-60 PRESS KIT ERRATA AND UPDATES
(CHANGES ARE UNDERLINED)

1. Page 7, STS-60 Quick Look:
Spacehab Experiments, Line 12: SOR/F ("Stirling" Orbiter Refrigerator/Freezer)
2. Page 8, STS-60 Quick Look:
Add under Spacehab Experiments: "SRE (Sample Return Experiment)"
3. Page 9, STS-60 Quick Look:
"DTO" 700-7: "Orbiter Data for Real-Time Navigation Evaluation."
4. Pages 10-11, STS-60 Summary Timeline:
Throughout Flight Days 1,2,3,4,6,7,8: Change "Spacehab vestibular experiments" to "vestibular experiments. The vestibular experiments will be performed in Discovery's middeck, not in the Spacehab module."
5. Page 13, STS-60 Orbital Events Summary:
For WSF Thrust, MET 02/03:51:00, Wake Shield Facility's "single thruster will fire" to provide separation from Discovery's vicinity.
6. Page 13, STS-60 Orbital Events Summary:
From WSF Thrust through the NC-4 burn, Discovery will be at distances as stated "ahead" of WSF, not "behind" WSF. The NC-4 burn will begin Discovery on a course that will move it from 40 nautical miles "ahead" of WSF to a point 8 nautical miles "behind".
7. Page 14, STS-60 Orbital Events Summary:
For Plume MNVRS at MET 04/03:43:00, Commander "and Pilot" will fire a series of thrusters at differing angles to WSF while flying in front of and behind WSF at ranges of 400, 300 and 200 feet. The thruster firings will gather information on how to avoid contaminating "and disturbing" rendezvous targets with thruster exhaust during close operations.
8. Page 15, STS-60 Crew Responsibilities:
For Remote Manipulator System, primary is Davis, backups/others are "Krikalev, Sega" only. For PSB, "Sega" is primary, the backup/other is Bolden. For SAREX-II, Krikalev is primary, backups/others are Bolden, "Sega". For DSO 200 (radiological), Reightler is primary, the backup/other is Krikalev. For DTO 700-2 (laser range), primary is Reightler, backups/others are "Chang-Diaz, Sega". For DTO 700-7, title is "(Orbiter Data For Real-Time Navigation Evaluation)."

-more-

9. Page 24, Release:
Paragraph 2, Sentence 3: "Mission Specialist Franklin Chang-Diaz" will use a hand-held laser...
10. Pages 24-25, Rendezvous:
Paragraph 2, Sentence 1: The retrieval of the Wake Shield Facility will begin with an engine firing by Discovery that will have the Shuttle leave its stationkeeping position 40 nautical miles "ahead" to close in on a point 8 nautical miles behind the facility.
11. Page 25, Shuttle Plume Impingement Tests:
Paragraph 1, Sentence 1: Bolden "and Reightler" will brake Discovery's approach to....
Sentence 2: At that point, Bolden "and Reightler"..
Sentence 3: The jet firings comprise a plume impingement test that will help characterize the "behavior" of the exhaust..
Last Sentence: Information from these test will be valuable in planning future retrievals and dockings by the Shuttle with other spacecraft in a method that avoids contaminating or "significantly disturbing" those spacecraft with the exhaust plumes.
12. Page 37, Space Experiment Furnace:
Paragraph 1, Sentence 1: The Space Experiment "Facility" ...
Paragraph 3, Sentence 1: ... temperatures up to approximately "800 degrees C"
13. Page 59, Crystallization Facility Experiments
Eliminate subhead, CFE is part of Commercial Protein Crystal Growth experiment.
Paragraph 4, Sentence 5: This information is graphed on the screen of the Powerbook for the astronauts to view "and react to".
14. Page 62, Space Acceleration Measurement System
Paragraph 6, Sentence 1: Insert subhead "Stirling Orbiter Refrigerator/Freezer"
15. Page 73, STS-60 Crew Biographies, Dr. Ronald M. Sega:
Paragraph 4: Sega has logged more than "4,000" flying hours as of Jan. 27, 1994.

PUBLIC AFFAIRS CONTACTS

For Information on the Space Shuttle

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For Information on NASA-Sponsored STS-60 Experiments

Charles Redmond Headquarters, Wash., D.C.	Wake Shield Facility Spacehab-2	202/358-1757
Debra Rahn Headquarters, Wash., D.C.	NASA-Russian Cooperation	202/358-1639
Mike Braukus Headquarters, Wash., D.C.	Microgravity and Life Sciences Experiments aboard STS-60s	202/358-1979
Terri Sindelar Headquarters, Wash., D.C.	SAREX-II	202/358-1977
Tammy Jones Goddard Space Flight Center Greenbelt, MD	Get Away Special (GAS) payloads	301/286-5566

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Release: 94-11

FIRST SHUTTLE MISSION OF 1994 TO INCLUDE RUSSIAN COSMONAUT

The first flight of the Space Shuttle in 1994, designated as STS-60, will be highlighted by the participation of a Russian astronaut serving as a crew member aboard Space Shuttle Discovery. The mission also will see the deployment and retrieval of a free-flying disk designed to generate new semiconductor films for advanced electronics and the second flight of a commercially developed research facility.

Leading the six-person STS-60 crew will be Mission Commander Charlie Bolden who will be making his third space flight. Pilot for the mission is Ken Reightler, making his second flight. The mission specialists for STS-60 are Jan Davis, Mission Specialist 1 (MS1) making her second flight, Ron Sega, Mission Specialist 2 (MS2) making his first flight, Franklin Chang-Diaz, the Payload Commander and Mission Specialist 3 (MS3) making his fourth flight and Sergei Krikalev, Mission Specialist 4 (MS4) who is a veteran of two flights in space, both long-duration stays aboard the Russian MIR space station.

Launch of Discovery on the STS-60 mission is currently scheduled for no earlier than February 3, 1994 at 7:10 a.m. EST. The planned mission duration is 8 days, 5 hours and 32 minutes. An on-time launch on February 3 would produce a landing at 12:42 p.m. EST on February 11 at Kennedy Space Center's Shuttle Landing Facility.

A new era of human space flight cooperative efforts between the United States and Russia will begin with the flight of Russian cosmonaut Sergei Krikalev as a member of the STS-60 crew. His flight aboard the Shuttle is the beginning of a three-phased program. Phase one will entail up to 10 Space Shuttle-Mir missions including rendezvous, docking and crew transfers between 1995 and 1997. Phase two is the joint development of the core international space station program. Phase three is the expansion of the space station to include all of the international partners.

The STS-60 mission will see the first flight of the Wake Shield Facility (WSF), a 12-foot diameter, stainless steel disk which will be deployed and retrieved using the Shuttle mechanical arm. While it flies free of the Space Shuttle, WSF will generate an "ultra-vacuum" environment in space within which to grow thin semiconductor films for next-generation advanced electronics. The commercial applications for these new semiconductors include digital cellular telephones, high-speed transistors and processors, fiber optics, opto-electronics and high-definition television.

The commercially developed SPACEHAB facility will make its second flight aboard the Space Shuttle during the STS-60 mission. Located in the forward end of the Shuttle cargo bay, it is accessed from the orbiter middeck through a tunnel and provides an 1100 cubic feet of working and storage space. Experiments being carried in SPACEHAB-2 involve materials processing, biotechnology and hardware and technology development payloads.

NASA's program affords the average person a chance to perform small experiments in space through the agency's Get Away Special (GAS) program. This flight will mark a major milestone because Discovery will fly the 100th GAS payload since the program's inception in 1982. GAS experiments on STS-60 will attempt to create a new kind of ball bearing, measure the vibration level during normal orbiter and crew operations and understand the boiling process in microgravity.

Two GAS payloads will involve deploying objects from the cargo bay. The Orbital Debris Calibration Spheres (ODERACS) payload will deploy six spheres which will be observed, tracked and recorded by ground-based radars and optical telescopes. The German-built BREMAN Satellite (BREMSAT) payload will conduct scientific activities at various mission phases before and after satellite deployment.

STS-60 crew members will take on the role of teacher as they educate students in the United States and Russia about their mission objectives and what it is like to live and work in space by using the Shuttle Amateur Radio Experiment-II (SAREX-II). Astronauts Bolden, Soga and Krikalev will operate SAREX. Operating times for school contacts are planned into the crew's activities.

STS-60 will be the 18th flight of Space Shuttle Discovery and the 60th flight of the Space Shuttle system.

- end -

MEDIA SERVICES INFORMATION

NASA Select Television Transmission

NASA Select television is now available through a new satellite system. NASA programming can now be accessed on Spacenet-2, Transponder 5, located at 69 degrees west longitude; frequency 3880.0 MHz, audio 6.8 MHz.

The schedule for television transmissions from the orbiter and for mission briefings will be available during the mission at Kennedy Space Center, Fla; Marshall Space Flight Center, Huntsville, Ala.; Dryden Flight Research Center, Edwards, Calif.; Johnson Space Center, Houston and NASA Headquarters, Washington, D.C. The television schedule will be updated to reflect changes dictated by mission operations.

Television schedules also may be obtained by calling COMSTOR 713/483-5817. COMSTOR is a computer data base service requiring the use of a telephone modem. A voice update of the television schedule is updated daily at noon Eastern time.

Status Reports

Status reports on countdown and mission progress, on-orbit activities and landing operations will be produced by the appropriate NASA newscenter.

Briefings

A mission press briefing schedule will be issued prior to launch. During the mission, status briefings by a Flight Director or Mission Operations representative and when appropriate, representatives from the payload team, will occur at least once per day. The updated NASA Select television schedule will indicate when mission briefings are planned.

STS-60 Quick Look

Launch Date/Site: Feb. 3, 1994/Kennedy Space Center - Pad 39A

Launch Time: 7:10 a.m. EST

Orbiter: Discovery (OV-103) - 18th Flight

Orbit/Inclination: 190 nautical miles/57 degrees

Mission Duration: 8 days, 5 hours, 32 minutes

Landing Time/Date: 12:42 p.m. EST Feb. 11, 1994

Primary Landing Site: Kennedy Space Center, Fla.

Abort Landing Sites: Return to Launch Site - KSC, Fla.
TransAtlantic Abort landing - Zaragoza, Spain
Ben Guerir, Morocco
Moron, Spain
Abort Once Around - Edwards AFB, Calif.

Crew: Charlie Bolden, Commander (CDR)
Ken Reightler, Pilot (PLT)
Jan Davis, Mission Specialist 1 (MS1)
Ron Sega, Mission Specialist 2 (MS2)
Franklin Chang-Diaz, Payload Commander (MS3)
Sergei Krikalev (RSA), Mission Specialist 4 (MS4)

Cargo Bay Payloads:

WSF-1 (Wake Shield Facility-1)
Spacehab-2 (Space Habitation Module-2)
CAPL/GAS Bridge experiments (Capillary Pumped Loop Experiment/Get-Away
Special canisters)

Spacehab Experiments:

3-DMA (Three-Dimensional Microgravity Accelerometer)
ASC-3 (Astroculture Experiment)
BPL (Bioserve Pilot Lab)
CGBA (Commercial Generic Bioprocessing Apparatus)
CPCG (Commercial Protein Crystal Growth)
ECLIPSE-Hab (Equipment for Controlled Liquid Phase Sintering)
IMMUNE-01 (Immune Response Studies)
ORSEP (Organic Separations Experiment)
SEF (Space Experiment Facility)
PSB (Penn State Biomodule)
SAMS (Space Acceleration Measurement System)
SOR/F (Spacehab Orbiter Refrigerator/Freezer)

Get Away Special (GAS) Experiments:

ODERACS (Orbital Debris Radar Calibration Spheres)
BREMSAT (University of Bremen Satellite)
G-071 (Ball Bearing Experiment)
G-514 (Orbiter Stability Experiment and Medicines in Microgravity)
G-536 (Heat Flux)
G-557 (Capillary Pumped Loop Experiment)

In-Cabin Payloads:

SAREX-II (Shuttle Amateur Radio Experiment-II)
APE-B (Auroral Photography Experiment)

Joint U.S.-Russian Investigations:

DSO 200: Radiological Effects
DSO 201: Sensory Motor Investigation
DSO 202: Metabolic
DSO 204: Visual Observations From Space

Other DTOs/DSOs:

DTO 623: Cabin Air Monitoring
DTO 656: PGSC Single Event Upset Monitoring
DTO 664: Cabin Temperature Survey
DTO 670: Passive Cycle Isolation System
DTO 700-2: Laser Range and Range Rate Device
DSO 700-7: Payload Bay Rendezvous Laser Data
DSO 325: Dried Blood Method for Inflight Storage
DSO 326: Orbiter Window Inspection
DSO 901: Documentary Television
DSO 902: Documentary Motion Picture
DSO 903: Documentary Still Photography

SPACE SHUTTLE ABORT MODES

Space Shuttle launch abort philosophy aims toward safe and intact recovery of the flight crew, Orbiter and its payload. Abort modes include:

- * Abort-To-Orbit (ATO) -- Partial loss of main engine thrust late enough to permit reaching a minimal 105-nautical mile orbit with orbital maneuvering system engines.
- * Abort-Once-Around (AOA) -- Earlier main engine shutdown with the capability to allow one orbit around before landing at Edwards Air Force Base, Calif.
- * TransAtlantic Abort Landing (TAL) -- Loss of one or more main engines midway through powered flight would force a landing at either Zaragoza, Spain; Ben Guerir, Morocco; or Moron, Spain.
- * Return-To-Launch-Site (RTL) -- Early shutdown of one or more engines, and without enough energy to reach Zaragoza, would result in a pitch around and thrust back toward KSC until within gliding distance of the Shuttle Landing Facility.

STS-60 contingency landing sites are the Kennedy Space Center, Edwards Air Force Base, Zaragoza, Ben Guerir, or Moron.

STS-60 Summary Timeline

Flight Day One

Ascent
OMS-2 burn (190 n.m. x 190 n.m.)
Spacehab activation
Joint Science Operations
CAPL activation
Group B powerdown
CPCG setup
Spacehab operations

Flight Day Two

Metabolic investigations
Remote Manipulator System checkout
Spacehab vestibular operations
SAREX setup

Flight Day Three

Wake Shield Facility grapple
Wake Shield Facility unberth
Group B powerup
Wake Shield Facility release (191 n.m. x 189 n.m.)
NC-1 burn (190 n.m. x 189 n.m.)
Group B powerdown
Spacehab operations

Flight Day Four

SAREX operations
Spacehab vestibular operations

Flight Day Five

Group B powerup
NC-4 burn (195 n.m. x 191 n.m.)
TI burn (191 n.m. x 188 n.m.)
Wake Shield Facility Plume Impingement Test
Wake Shield Facility grapple (191 n.m. x 189 n.m.)
Group B powerdown

Flight Day Six

Spacehab vestibular operations
Wake Shield Facility operations
Wake Shield Facility berth
Spacehab vestibular operations
Orbit Adjust burn (If required: 191 n.m. x 183 n.m.)

Flight Day Seven

SAREX operations
Spacehab vestibular operations
Group B powerup
ODERACS deploy
BREMSAT deploy
Crew press conference
Spacehab vestibular operations
Group B powerdown

Flight Day Eight

Reaction Control System hot fire
Flight Control Systems checkout
Spacehab vestibular operations
Spacehab stow
Cabin stow

Flight Day Nine

Group B powerup
Spacehab final deactivation
Deorbit preparation
Deorbit burn
Entry
Landing

STS-60 Vehicle and Payload Weights

Vehicle/Payload	Pounds
Orbiter (Discovery) empty and 3 SSMEs	173,117
Wake Shield Facility (deployable)	3,710
Wake Shield Facility (cargo bay support equipment)	3,770
Capillary Pumped Loop Exp./Gas Bridge Assembly	5,136
Spacehab-2	9,452
SAREX-II	50
DSOs/DTOs	437
Total Vehicle at SRB Ignition	4,507,961
Orbiter Landing Weight	214,832

STS-60 Orbital Events Summary

EVENT	START TIME (dd/hh:mm:ss)	VELOCITY CHANGE (feet per second)	ORBIT (n.m.)
OMS-2	00/00:45:00	267 fps	191 x 189
WSF release	02/03:50:00	n/a	191 x 189
WSF thrust (WSF's thrusters fire to provide separation from Discovery's vicinity)	02/03:51:00	1.5 fps	190 x 189
NC-1 (fired when Discovery is about 10 n.m. behind WSF, begins slow drift over next 12 orbits to a point about 40 n.m. behind WSF)	02/08:27:00	0.6 fps	190 x 189
NC-2 (if required, maintains Discovery at about 40 n.m. behind WSF)	03/01:14:00	TBD	190 x 189
NPC (if required, aligns Discovery's groundtrack with WSF's groundtrack)	03/07:00:00	TBD	190 x 189
NC-3 (if required, maintains Discovery at about 40 n.m. behind WSF)	03/08:00:00	TBD	190 x 189
NC-4 (fired at 40 n.m. behind WSF, begins closing in on WSF, initiates closing rate of about 16 n.m. per orbit to arrive at a point 8 n.m. behind WSF after two orbits)	03/23:06:00	9 fps	195 x 189
NH-1 (if required, adjusts Discovery's altitude as it closes on WSF)	03/23:52:00	TBD	190 x 189
NCC (first burn calculated by onboard computers using onboard navigation derived from orbiter star tracker sightings of WSF; fine-tunes course while orbiter is closing in on a point 8 n.m. behind WSF)	04/01:12:00	TBD	195 x 191
TI (fired upon arrival at a point 8 n.m. behind WSF; begins terminal interception of WSF)	04/02:09:00	12 fps	191 x 188
MC1-MC4 (mid-course corrections, if required; calculated by onboard computers, double-checked by ground; designed to fine-tune final course toward WSF, may or may not be required)	TBD	TBD	TBD

MANUAL	04/03:20:00	TBD	TBD
(Begins about 4 hours, 40 minutes prior to WSF grapple, less than 1 nautical mile from WSF, passing below it. Commander takes manual control of orbiter flight, fires braking maneuvers to align and slow final approach to WSF and begins an almost four-hour long series of proximity operations designed to study the characteristics of Discovery's thruster exhaust during rendezvous)			
PLUME MNVRS	04/03:43:00	n/a	n/a
(Commander fires a series of thrusters at differing angles to WSF while flying in front of and behind WSF at ranges of 400, 300 and 200 feet. The thruster firings will gather information on how to avoid contaminating rendezvous targets with thruster exhaust during close operations.)			
GRAPPLE	04/08:00:00	TBD	191 x 189
(WSF is captured using Discovery's mechanical arm)			
OA	05/07:45:00	TBD	TBD
(If required, burn to adjust Discovery's orbit for landing opportunities and deploy of ODERACS and BREMSAT)			
ODERACS	06/02:45:00	n/a	191 x 189
(ODERACS spheres are deployed)			
BREMSAT	06/07:39:00	n/a	191 x 189
(University of Bremen satellite is deployed)			
DEORBIT	08/04:28:00	335 fps	n/a
LANDING	08/05:32:00	n/a	n/a

NOTE: All planned burns are recalculated in real time once the flight is under way and will likely change slightly. Depending on the accuracy of the orbiter's navigation and course at certain times, some smaller burns listed above may not be required. However, the times for major burns and events are unlikely to change by more than a few minutes.

STS-60 CREW RESPONSIBILITIES

TASK/PAYLOAD	PRIMARY	BACKUPS/OTHERS
Wake Shield Facility	Sega	Krikalev, Chang-Diaz
Remote Manipulator Sys.	Davis	Krikalev, Sega, Reightler
ODERACS	Bolden	Reightler
BREMSAT	Bolden	Chang-Diaz

Get-Away Special (GAS) Bridge experiments:

CAPL/GBA	Krikalev	Sega
GAS 514	Davis	Chang-Diaz
GAS 071	Davis	Chang-Diaz
GAS 536	Davis	Chang-Diaz
GAS 557	Davis	Chang-Diaz

Spacehab experiments:

Spacehab systems	Chang-Diaz	Davis, Sega, Krikalev
SAMS	Krikalev	Sega
3-DMA	Krikalev	Chang-Diaz
ORSEP	Bolden	Davis
CPCG	Davis	Chang-Diaz
BPL	Krikalev	Chang-Diaz
CGBA	Davis	Reightler
SEF	Chang-Diaz	Davis
ECLIPSE	Reightler	Sega
IMMUNE	Krikalev	Reightler
ASC-3	Chang-Diaz	Krikalev
PSB	Davis	Bolden

Middeck experiments:

SAREX-II	Krikalev	Bolden
APE-B	Chang-Diaz	Krikalev

Joint U.S.-Russian medical investigations:

DSO 200 (radiological)	Krikalev	Chang-Diaz
DSO 201 (sensory)	Sega	Davis, Krikalev, Reightler
DSO 202 (metabolic)	Chang-Diaz	Bolden, Reightler
DSO 204 (visual obs)	Krikalev	Chang-Diaz

Detailed Test Objectives (DTOs):

DTO 623 (cabin air)	Sega	Bolden
DTO 656 (PGSC upset)	Sega	Reightler
DTO 664 (cabin temp)	Sega	Davis
DTO 670 (passive cycle)	Sega	Reightler
DTO 700-2 (laser range)	Reightler	Sega, Chang-Diaz
DTO 700-7 (plb laser)	Reightler	Sega, Chang-Diaz

Other Responsibilities:

Photography/TV	Chang-Diaz	Davis
Earth observations	Chang-Diaz	Krikalev
In-flight maintenance	Krikalev	Bolden
Medic	Bolden	Davis
EVA (not planned)	Chang-Diaz (EV1)	Davis (EV2), Reightler (EV3)

Wake Shield Facility (WSF)

The Wake Shield Facility (WSF) is a 12-foot diameter, stainless steel disk designed to generate an "ultra-vacuum" environment in space within which to grow thin semiconductor films for next-generation advanced electronics. This mission represents the first time, internationally, in which the vacuum of space will be used to process thin film materials. The STS-60 astronaut crew will deploy and retrieve the WSF during the 9-day mission. The NASA Office of Advanced Concepts and Technology (OACT) is the sponsor of the WSF-1 flight on this mission of Space Shuttle Discovery.

The WSF is designed, built and managed by the Space Vacuum Epitaxy Center (SVEC) -- a NASA Center for the Commercial Development of Space (CCDS) based at the University of Houston, Houston, Texas -- with its principal industry partner, Space Industries, Inc. (SII), League City, Texas. Six additional corporate partners support the WSF program, including: American X-tal Technology, Dublin, Calif.; AT&T Bell Labs, Murray Hill, N.J.; Instruments, S.A., Inc., Edison, N.J.; Ionwerks, Houston, Texas; Quantum Controls, Houston, Texas; and Schmidt Instruments, Inc., Houston, Texas. In addition, the University of Toronto, NASA Johnson Space Center, the U.S. Air Force Phillips Laboratories and the U.S. Army Construction Engineering Research Laboratory are members of the SVEC consortium.

The principle objectives of the WSF-1 mission include:

- o The characterization of the "ultra-vacuum" environment generated by the WSF in low Earth orbit (LEO) space, and the flow field around the WSF, and
- o Molecular Beam Epitaxy (MBE) - growth of a thin film of the compound Gallium Arsenide (GaAs).

These objectives may have a significant impact on the microelectronics industry because the use of improved GaAs thin film material in electronic components holds a very promising economic advantage. The commercial applications for high quality GaAs devices are most critical in the consumer technology areas of digital cellular telephones, high-speed transistors and processors, high-definition television (HDTV), fiber optic communications and opto-electronics.

The majority of electronic components used today are made of the semiconductor silicon, but there are many other semiconductors of higher predicted performance than silicon. A current example of this prediction is the material Gallium Arsenide (GaAs). Devices made from GaAs could be about 8 times faster than silicon devices and take 1/10 the power. However, GaAs of high enough quality to reach this predicted performance level does not exist. If high quality GaAs could be produced, the devices made from it would represent nothing less than a technological revolution.

If improved GaAs material were available, it could significantly impact the global semiconductor market. The 1990 worldwide semiconductor consumption was \$56.8 billion. Of this amount, about 40% went for computers, 18% for telecommunications

and 15% for military applications. The projected market for 1994 is \$109 billion. Within this giant market, GaAs currently holds only a 0.5% niche. It is predicted that the niche for GaAs should grow to 2% (or about \$2.2 billion) by 1995, which could significantly increase with the availability of improved GaAs material.

A method to generate such advanced material is by thin film growth of the material in a vacuum environment. This technique, known as epitaxy, is limited by the vacuum conditions in vacuum chambers on Earth. To improve the material, the vacuum environment where it is grown must be improved.

Low-Earth orbit (LEO) space can be used to grow GaAs (and other materials) epitaxially, by creating a unique vacuum environment or "wake" behind an object moving in orbit. There is a moderate vacuum in LEO space with very few atoms present. A vehicle in orbit, such as the WSF, pushes even those few atoms out of the way, leaving fewer atoms, if any, in its wake. This unique "ultra-vacuum" produced in space by the WSF will be 1,000-10,000 times better than the best vacuum environments in laboratory vacuum chambers. Using this unique "ultra-vacuum" property of space, the WSF holds the promise of spawning orbiting factories to produce the next generation of semiconductor materials and the devices they will make possible.

Program Overview

The space "ultra-vacuum" concept was first described within NASA more than twenty years ago, but there was no need identified at that time for the use of an "ultra-vacuum." Recent interest by scientists and corporate researchers in epitaxial thin-film growth has motivated the use of space to create the "ultra-vacuum" in which to grow better thin films.

Recognizing this scientific opportunity as a new economic opportunity, in 1987 SVEC formed a consortium of interested industries, academic institutions and government laboratories to utilize the LEO vacuum environment in thin film growth. In 1989, SVEC partnered with its industry members led by Space Industries, Inc., and with NASA Johnson Space Center to build the WSF using a timely and cost-effective manner required of a commercially-oriented endeavor.

Prior to 1989, preliminary studies indicated that the WSF would be a disk or shield about 12-14 feet in diameter, and would be deployed from the Shuttle payload bay on the Shuttle "arm." The WSF hardware development program was soon projected to be complex, time intensive and quite costly, and it was mutually decided by NASA and SVEC that a more cost-effective and timely approach must be identified. The result was the effort by SVEC, Space Industries, Inc., and the rest of the SVEC industrial partners to create a non-traditional, commercial approach to space hardware development, and hence space infrastructure development. Through this mode of operation, the WSF will fly in nearly 1/2 the time required under a traditional approach, and at less than 1/6 the cost for a traditional aerospace hardware development program.

The primary objectives for the WSF-1 mission (listed above) remain as outlined by SVEC in March 1989. It should be noted that both of these primary objectives will be major "firsts" in space science and technology. The generation and characterization of the "ultra-vacuum" in LEO and its utilization for thin-film growth have never been attempted before, and as a result, represent additional risk for the SVEC-developed space thin film science and technology. These objectives, however, form the foundation of the SVEC principle of taking a basic science concept, identifying an application of it, developing a technology from the application, and identifying and producing a product from that technology.

A major contributor to the success of the WSF program will be Discovery's crew, especially Dr. Ronald Sega. Dr. Sega is a Co-Principal Investigator on the WSF program, with Dr. Alex Ignatiev, SVEC Director. The close SVEC interaction with the crew, pre-flight, has proven extremely beneficial for optimizing the complex WSF operation of unberthing, cleaning, deployment, rendezvous and capture. The crew also has contributed to the tuning of the WSF's science and technology operations for maximized data return from this first mission of the WSF and will play a major role in assuring its success.

Hardware Description

The WSF consists of the Shuttle Cross Bay Carrier (SCBC) and the Free Flyer. The SCBC remains in the Shuttle and has a latch system which holds the Free Flyer to the Carrier. The Shuttle "arm" or Remote Manipulator System (RMS) is attached to the Free Flyer for deployment and free flight in space. The SCBC has an extended-range, stand-alone RF communications system that lets the WSF seem like an attached payload to the Shuttle's systems, even when the Free Flyer is following behind the Shuttle at its stationkeeping distance of 40 nautical miles.

The Free Flyer is a fully-equipped spacecraft on its own, with cold gas propulsion for separation from the Shuttle and a momentum bias attitude control system (ACS). Forty-five kilowatt-hours of energy, stored in silver-zinc batteries, are available to power the thin film growth cells, substrate heaters, process controllers, and a sophisticated array of characterization devices. Weighing approximately 9,000 lbs. (the Free Flyer alone is 4,000 lbs.), the WSF occupies one quarter of the Shuttle payload bay. Controlling electronics, attitude control system, batteries and solar panels, and MBE process control equipment are on the back (wake side) of the WSF, while the avionics and support equipment are located on the front (ram side).

The commercial approach used to create the WSF has facilitated the development of several critical pieces of supporting hardware which have proven to be extremely useful and valuable in their own right. The development of an inexpensive carrier (the SCBC), a versatile ground link, and an innovative communications link between the Shuttle and the WSF have each been valuable spin-offs from the WSF program.

WSF Physical Characteristics

Free-Flyer	Vacuum welded 304L SS structure, UHV finish on wake side, 12 ft. dia. x 6 ft.
Carrier	7075-T73 aluminum alloy, dual trunnion, doubly redundant stand alone latch system
Weight	8,000 lbs. total, 3,800 lbs. deployable
Power	Ag-Zn batteries, 45 Kwatt-hr. @ 28 Vdc
Attitude Control System	Momentum bias (10 ft.-lb.-sec.), horizon scanner, 2-axis magnetometer, 3-axis magnetic torquer

WSF Characterization Equipment

Total Pressure Gauges (TPG)	2 10^{-5} torr- 10^{-8} torr; 3 10^{-7} torr- 10^{-10} torr
Mass Spectrometers (TOF-MS)	2 1-150 amu, 2 10^{-14} torr time-of-flight, programmable data integration time
Retarding Potential Analyzers	3 ram flux plasma diagnostics, 2 wake side Langmuir probe
3-axis Accelerometers	3 1g- 10^{-6} g
Wake side video camera	Compressed video interleaved with telemetry stream

The WSF as a Versatile Space Platform

As a free-flying platform, the WSF's wake side -- the ultra-clean side -- is used exclusively for ultra-pure thin film growth. The ram side -- the relatively dirty side -- of the 12 ft.-diameter WSF, however, can be used to accommodate other experiments and space technology applications. The ram side has a significant area of high quality "real estate" in the form of the outer shield -- more than 65 sq. ft. -- which can be applied to the support of other space payloads. The ram side contains four payload attach points, each capable of accommodating 200 pounds of experiment hardware.

In addition, since the WSF is mounted horizontally in the Shuttle payload bay, it was obvious early-on that the open volume of the Shuttle payload bay below the WSF could be used effectively by mounting additional payload canisters on the SCBC. The SCBC has power and data capabilities which were extended to the payload canisters, thus prompting their name -- "Smart Cans." The "Smart Cans," based on the NASA Goddard Space Flight Center Get Away Special Canisters (GAS cans), also provide the opportunity for other payloads to fly with the WSF (however, staying inside the Shuttle payload bay during the mission).

What is Epitaxial Thin Film Growth?

Epitaxial thin film growth is an approach to reducing the defects in semiconductor materials, such as GaAs, through the growth of new material on a substrate in a vacuum. In epitaxial growth, atomic or molecular beams of a material, such as arsenic (As) and gallium (Ga), formed in a vacuum are exposed to a prepared surface -- or substrate. The substrate is an atomic template, or pattern, upon which the atoms form thin films. The atoms grow in layers which follow the crystal structure pattern of the substrate. A thin film of new materials then grows on top of the substrate in an atom-by-atom layer, atomic layer-by-atomic layer manner to form a "wafer" with an ultra-high purity top region. This growth technique is defined as Molecular Beam Epitaxy (MBE), and has been used as a laboratory technique for studies in new thin film electronic materials for the past 20 years. It has been shown during this time that the vacuum environment within which the materials are grown is critical to the quality of the thin film grown.

The WSF has the capability of growing epitaxial thin films on seven different substrate wafers. GaAs will be the materials system grown on the WSF-1 flight, with each specific wafer growth tuned for unique thin film parameters. There will be at least one "thick" GaAs film grown (~9 micrometers) for the characterization of ultimate defect densities. In addition, there will be several films grown to exhibit high electron mobility in GaAs and films grown to support the Earth-based fabrication of field effect transistors. Finally, there will be a GaAs film grown by Chemical Beam Epitaxy (CBE) through the use of arsenic (As) and an organometallic compound containing gallium (Ga). The near-infinite vacuum pumping speed of the WSF ultra-vacuum environment should allow for the extremely rapid removal of the residual organic species found during CBE growth, and hence should greatly improve the quality of the grown GaAs film.

Cooperative Experiments

The University of Toronto Institute for Aerospace Studies (UTIAS) will also be performing exposure experiments aboard WSF-1 as a follow-up to its Long Duration Exposure Facility (LDEF) studies.

A NASA CCDS, the Center for Materials for Space Structure (CMSS), based at Case Western Reserve University, Cleveland, Ohio, is conducting an experiment to test different materials and coatings in space to determine how they degrade in the space environment. The experiment is known as MatLab-1, for Materials Laboratory-1. Industrial contributors to the MatLab-1 experiment include Westinghouse-Hanford, Martin Marietta, TRW, Rosemount, 3M, Dow Corning and McDonnell Douglas. Supporting government organizations include NASA Lewis Research Center and the Jet Propulsion Laboratory.

The MatLab-1 will be on the Materials Flight EXperiment (MFLEX) carrier mounted on the front of the WSF (ram side). Each experiment is considered "active," i.e., the material has an electronic sensor attached to it, which is placed into a tray connected to the electronics equipment. The MFLEX will scan the sensors and relay the information back to Earth via the WSF communications link. Material scientists on Earth can monitor the experiments in real-time and determine the performance of each material and coating interaction with the space environment.

The MatLab-1 experiment will test many materials in the actual environment in which they would be used to ensure "expected" performance. The materials will be tested for thermal cycling, strain, micro-debris, atomic oxygen erosion and its scattering effects, and the effects of ultra-violet rays. These materials may then be used in the construction of products for the space environment.

For example, the materials needed to build a rocket, satellite or space station must meet stringent requirements in weight and durability, given the harsh environment of space. Testing materials onboard the MatLab-1 experiment provides advance information to government and corporate planners about how some materials react in space. In order to reduce launch costs based on a spacecraft's weight, researchers are looking for lighter-weight materials that have the strength to survive a launch into space. Also, they are looking for durable, long-lasting materials that can withstand a lengthy stay in space to reduce replacement costs of valuable assets -- like a satellite that could orbit the Earth for 30 years instead of deteriorating sooner, requiring a new satellite to take its place.

The Geophysics Directorate at the U.S. Air Force Phillips Laboratory located at Hanscom Air Force Base (30 miles NW of Boston, Mass.), working with SVEC, studies the flow fields of charged particles in the Wake Shield's vicinity. AFGL will fly the Charging Hazards and Wake Studies (CHAWS) experiment on the WSF Free Flyer. The general purpose of the experiment is to increase understanding of the interactions of the space environment with space systems and the hazards such interactions pose. The improved understanding of spacecraft environmental interactions derived from CHAWS results will enhance both the commercial and military utilization of space. For instance, CHAWS results may lead to the design and operation of higher powered satellites in orbit.

The two specific goals of the CHAWS experiment are 1) to measure the ambient, low-energy population of positively-charged particles on both the front and back of the WSF, and 2) to study the magnitude and directionality of the current collected by a negatively-charged object in the plasma wake as a function of the ambient-charged particle density and the orientation of the WSF and the Shuttle. The CHAWS experiment data are crucial to achieving part of the primary mission goal of characterizing the neutral and charged particle wake created by WSF-1.

The CHAWS experiment consists of two sensor units and a controller. At the heart of each sensor unit are a series of newly developed, state-of-the-art, compact particle detectors able to measure a wide range of charged particle densities down to low densities previously difficult or impossible to measure. In the spirit of the WSF program, the STS-60 mission will provide the first flight test of this new technology.

The most intensive portion of the CHAWS experiment will be conducted after WSF recapture. With the WSF held by the Shuttle "arm," the Shuttle attitude will be varied with respect to the direction of orbital motion so that the full wake can be mapped by varying the sensor's location in the wake region. In addition, measurement will be made of any optical emissions produced near the sensor during high voltage activities. These measurements will be the first ever made in space of the current collected by a negatively-charged object in the wake of a space structure in low Earth orbit.

Working with NASA Johnson Space Center (JSC) engineers, SVEC is offering the WSF as a testbed for the development of highly sensitive accelerometers, called the Microgravity Measurement Devices (MMD). Accelerometers measure low levels of acceleration by a vehicle in space. Specifically on WSF-1, the accelerometers will characterize the microgravity environment of the WSF Free Flyer. Given the largely passive thin film growth process, the WSF Free Flyer promises to be a "true" microgravity platform, ideal for any number of future materials processing chores. The MMD will be the linchpin for another joint experiment between SVEC and JSC: an ambitious Shuttle Plume Impingement Experiment (PIE) in support of space station development. A critical concern to space station planners is the complex interaction between Shuttle attitude control thruster firings and nearbyspace structures; however, little information exists in this area. The WSF Free Flyer, loaded with environmental diagnostic equipment, is the ideal target for this study, as a cost-effective means to multiply benefits to differing program goals. A complex and extensive series of thruster firings have been planned to use the WSF's response to measure the characteristics of the Shuttle's thruster plumes.

Two "Smart Cans" will be attached to the WSF's SCBC on this flight to conduct a Containerless Coating Process (CONCOP-1) experiment. The United States Army Construction Engineering Research Laboratory (CERL) in Champaign, Ill., will be using the "Smart Cans" for an investigation of hot filament thin film metals deposition on a variety of materials. The results will give researchers information about applying reflective coatings to space structures while in space. While the Free Flyer is behind the Shuttle, the crew will activate the CERL experiment for follow-on operations controlled through the payload operations center.

Two student experiments will be a part of WSF-1. "Fast Plants" will be coordinated by Hartman Middle School, Houston, Texas, to study the effects of space radiation on plants' generation. Brassica rapa plants supplied by the University of Wisconsin will be exposed to the entire spectrum of radiation from space while velcro-mounted to the SCBC.

Brassica rapa's rapid growth rate of 38 days per generation will allow numerous generations to be studied during a single school year following the WSF-1 flight. Six Houston Independent School District middle schools will be involved in the experiment.

Students will not only grow plants and gather data, but will become proficient at controlling variables while learning how to conduct a long-term experiment. Data will be compiled for the purpose of writing and submitting a paper to a scientific publication, rounding out a rich educational experience.

Ninth grade students at the Gregory Jarvis Junior High School, Mohawk, N.Y., will be determining the orbital variation of the Earth's magnetic field from electron diffraction data obtained in the WSF thin film growth experiments. The electron beam used for in situ diffraction measurement of the atomic structure of the growing GaAs films is deflected by the Earth's magnetic field. This deflection can be used to define the magnitude and direction of the Earth's magnetic field as a function of orbital position. The junior high school students will work with SVEC researchers in applying elementary physical laws to directly extract Earth magnetic field information from the WSF data.

Mission Scenario

The Wake Shield Facility will be released from Discovery to fly free for about 48 hours, gathering its experiment information before it is retrieved by the Shuttle. Once it is retrieved, the facility will remain captured at the end of Discovery's remote manipulator system (RMS) mechanical arm overnight, for a total of about 17 hours, to gather further data before it is berthed in the cargo bay for the return to Earth.

Release

On Flight Day 3, the WSF will be grappled by the Shuttle "arm" and removed from the SCBC. The WSF will be positioned by the "arm" to be "cleaned" by the highly reactive atomic oxygen found in low Earth orbit and by the sun's heat. The "cleaning" will last 3 hours. Some tests will be run during this "cleaning," such as radio checks between the SCBC and the Free Flyer, checks of the Free Flyer batteries, and activation of the primary video camera on the wake side of the Free Flyer.

Three successive approximately 45-minute long windows exist for deploying the facility on the third day of STS-60, as well as backup opportunities later in the mission. During the release operations, Commander Charlie Bolden will be at the aft flight deck controls of Discovery, Mission Specialist Jan Davis will operate the mechanical arm, and Mission Specialist Ron Sega will oversee the Wake Shield Facility's systems and experiments. Pilot Ken Reightler will use a hand-held laser range-finding device as well as a similar device mounted in Discovery's cargo bay to provide information on the distance and separation rate of the facility. The data supplement information provided by the Shuttle's rendezvous radar system. Mission Specialist Franklin Chang-Diaz will document the events with still photography, video and film.

After the "cleaning" is done, the "arm" will move the WSF to a position that will allow the formation of a vacuum wake behind the WSF. There will be approximately one hour of vacuum measurements and checkouts in this position. Then the arm will move the WSF to the release position, over the starboard (right) side of the Shuttle payload bay. The Free Flyer will separate from the arm and move behind the Shuttle to remove it from Shuttle contamination sources (i.e., water dumps, fuel cell purges and engine firings). The astronauts will fire a thruster if necessary to keep the WSF safely behind the Shuttle while they are sleeping.

The WSF will stay 40 nautical miles behind the Shuttle while growing the thin films. The WSF will be operated during this time from the Payload Operations Control Center (POCC) at the NASA Johnson Space Center. The SVEC POCC team will monitor and control all aspects of WSF operations in close cooperation with the astronaut crew.

Rendezvous

On Flight Day 5, the Shuttle will rendezvous with the Free Flyer. Every member of the STS-60 crew has a vital role to play during the WSF rendezvous and capture and the integral plume experiment. Charles Bolden, Commander, and Kenneth Reightler, Pilot, will pilot Discovery through a complex series of maneuvers in approaching the WSF.

The retrieval of the Wake Shield Facility will begin with an engine firing by Discovery that will have the Shuttle leave its stationkeeping position 40 nautical miles behind to close in on a point about 8 nautical miles behind the facility. Over the next three hours, as Discovery closes in on a point 8 nautical miles behind the Wake Shield Facility, the Shuttle's navigation will be continually refined as will tracking information on the facility itself. The final engine firing performed will be calculated by the Shuttle's onboard navigation systems, rather than by ground controllers. At a distance of 8 nautical miles behind the facility, Mission Specialist Sergei Krikalev will power up the mechanical arm and move it into position for the impending capture, and Discovery will fire its engines to perform a terminal interception (TI) burn, a firing that will put the Shuttle on a course directly for the facility. The Shuttle may perform four small course correction firings during its final approach before Bolden takes over manual control of Discovery's flight as the Shuttle passes less than one nautical mile below the facility.

Shuttle Plume Impingement Tests

Ron Sega and Sergei Krikalev will coordinate the plume experiment initiation and data acquisition. Franklin Chang-Diaz will track the WSF position by video and Jan Davis will prepare the Shuttle "arm" for WSF capture.

Bolden will brake Discovery's approach to the Wake Shield Facility, eventually flying to about 400 feet directly in front of the facility. At that point, Bolden will begin an almost four-hour long series of maneuvers that will have Discovery perform precise steering jet firings at various angles to the Wake Shield Facility. The jet firings comprise a plume impingement test that will help characterize the behaviour of the exhaust emitted by Discovery's jets. With its contamination-sensitive experiments already completed at that time, the Wake Shield's instruments can measure the makeup of the exhaust plume, accelerations the plumes cause, and the pressures of the exhaust. During the tests, Bolden will fly Discovery from in front of the facility to pass above and behind it. The jet firings will be performed in front of the Wake Shield at ranges of 400 feet, 300 feet and 200 feet, and from behind the facility at a range of 200 feet. Information from these tests will be valuable in planning future retrievals and dockings by the Shuttle with other spacecraft in a method that avoids contaminating those spacecraft with the exhaust plumes.

Retrieval

The final approach to within capture range of the Wake Shield Facility will be done from behind it, with Bolden moving Discovery to within 35 feet of the Free-Flyer. Krikalev will then capture the Wake Shield using the mechanical arm. Krikalev will then place the arm in a parked position with the Wake Shield held above the payload bay during the astronaut sleep period for extended WSF environmental measurement.

On Flight Day 6, the CHAWS experiment will be performed. The astronauts will position the WSF to the point above the overhead windows for maneuvering of the WSF to gather plasma flow data around the WSF. The Air Force Auroral Photography Experiment B (APE-B) camera will be used in support of the plasma flow studies to view the Shuttle glow phenomenon on the CHAWS plasma probe from the Shuttle's aft flight deck windows. Plasma flow data will be acquired for two full orbits, after which the WSF will be re-stowed into the SCBC for return to Earth.

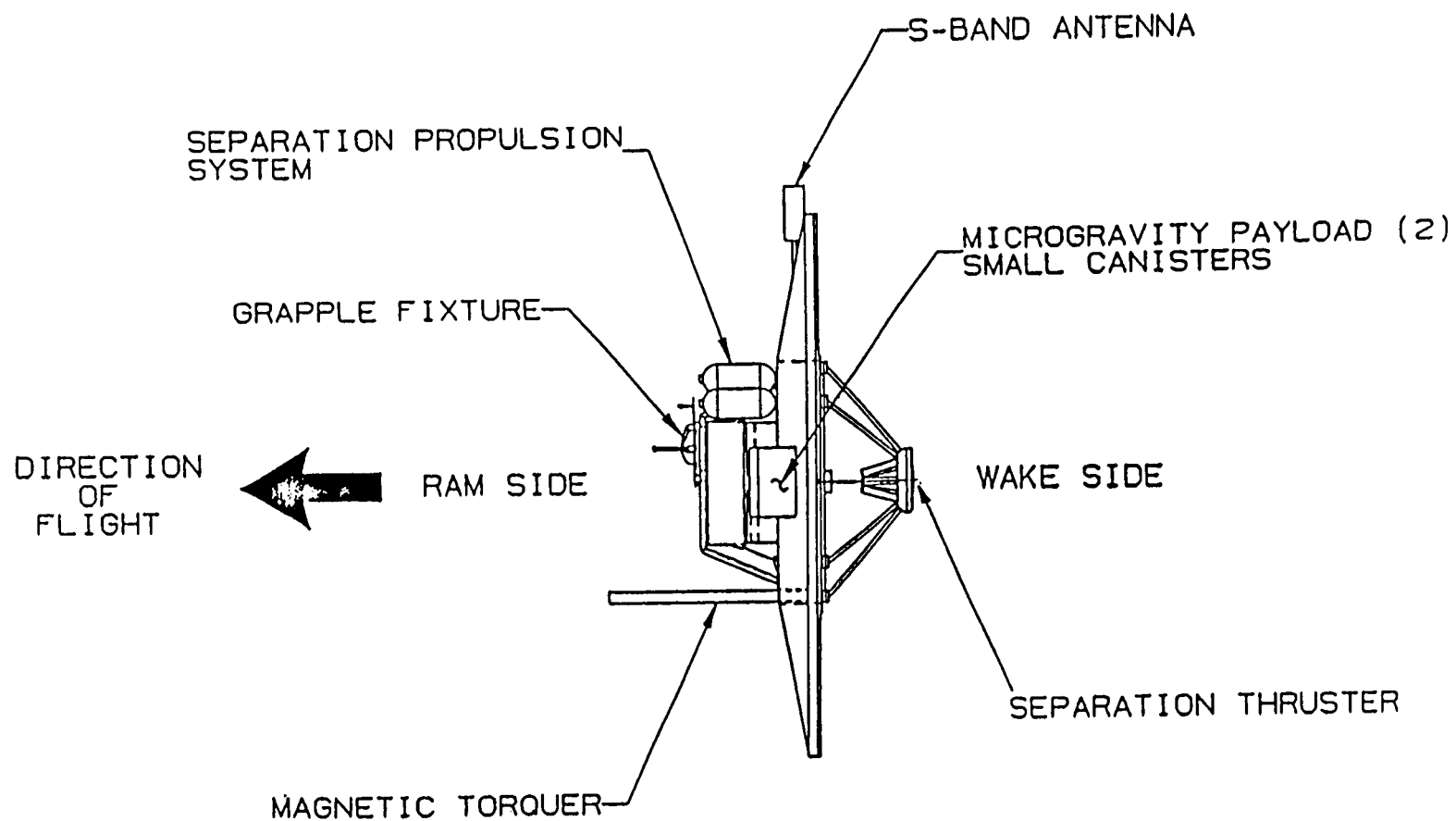
Future Plans for the WSF Program

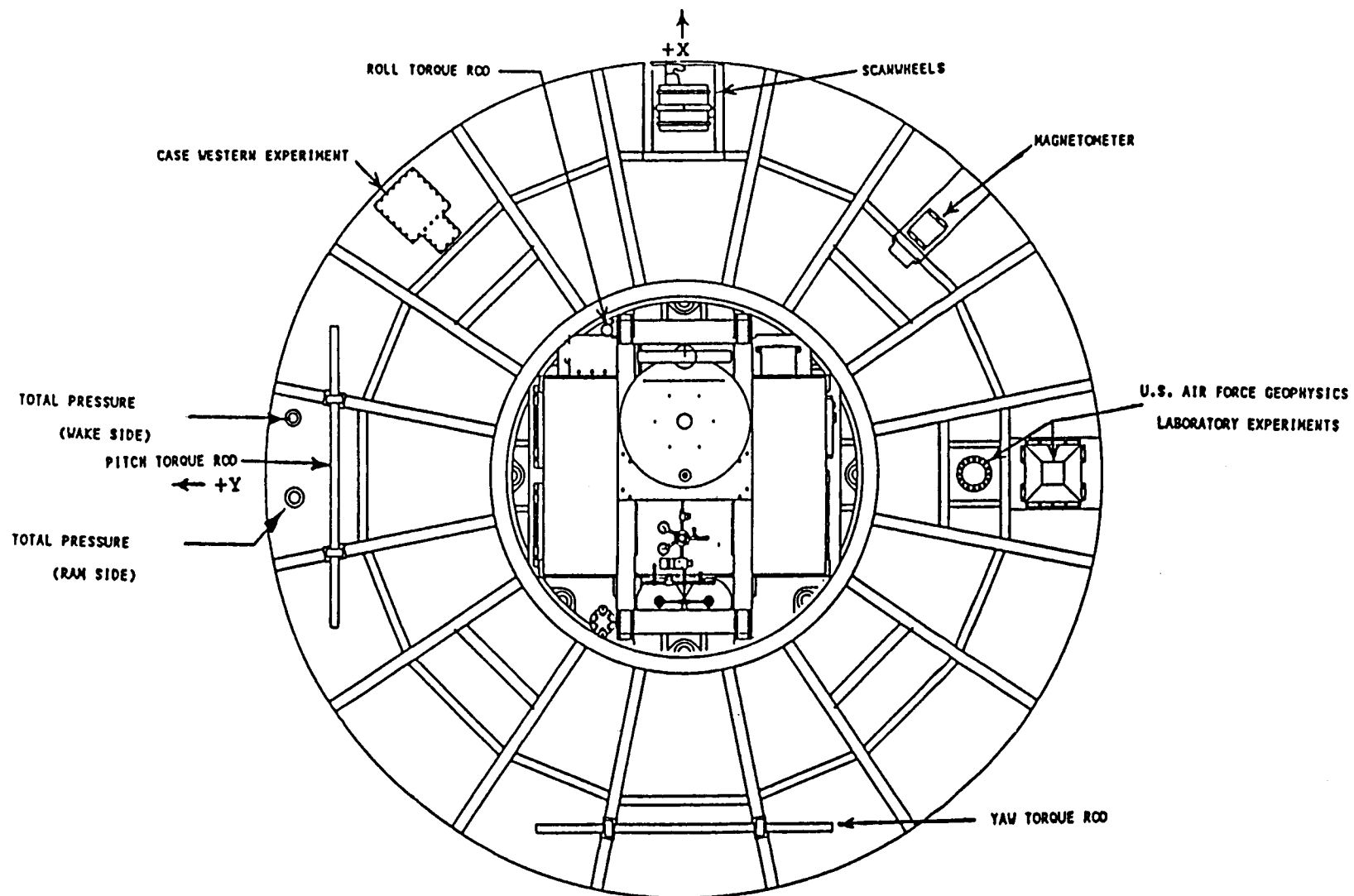
The WSF Program consists of four flights basically flying at one year intervals. During the four flights, the WSF program first will provide the "proof-of-concept" demonstration of thin film growth in space techniques required for industry to fully embrace the space epitaxial growth technology. Second, it will demonstrate the ability to grow commercial quantities of epitaxial thin films in space. To accomplish these goals, the WSF Program is designed to evolve with the WSF-2 flight (1995) expected to show increased capability in number and types of thin films grown, and in command and control of the growth process through ground operations from a commercial payload command and control center (POCC). WSF-3 (1996) is expected to see the addition of solar panels, additional central processing power, and robotic substrate sample manipulation for extended orbital operations. WSF-4 (1997) is expected to have the capability of processing up to 300 epitaxial thin film wafers.

Beyond the first "proof-of-concept" flights of WSF, full commercial use of the WSF is projected. The commercial phase of the program is being termed "Mark II" -- a 5-year orbiting WSF free flyer. Because the weight of the Free Flyer is 4,000 lb., it would not be economically realistic to launch and retrieve the complete WSF for every batch of thin film wafers grown (about 300 wafers per batch). It is clearly more suitable to launch only the raw materials and bring back only the finished wafers, leaving the WSF in space. Therefore, the "Mark II" would be launched into orbit and then be periodically visited by a dedicated service vehicle that would replenish the raw materials and bring back the finished wafers.

Conclusion

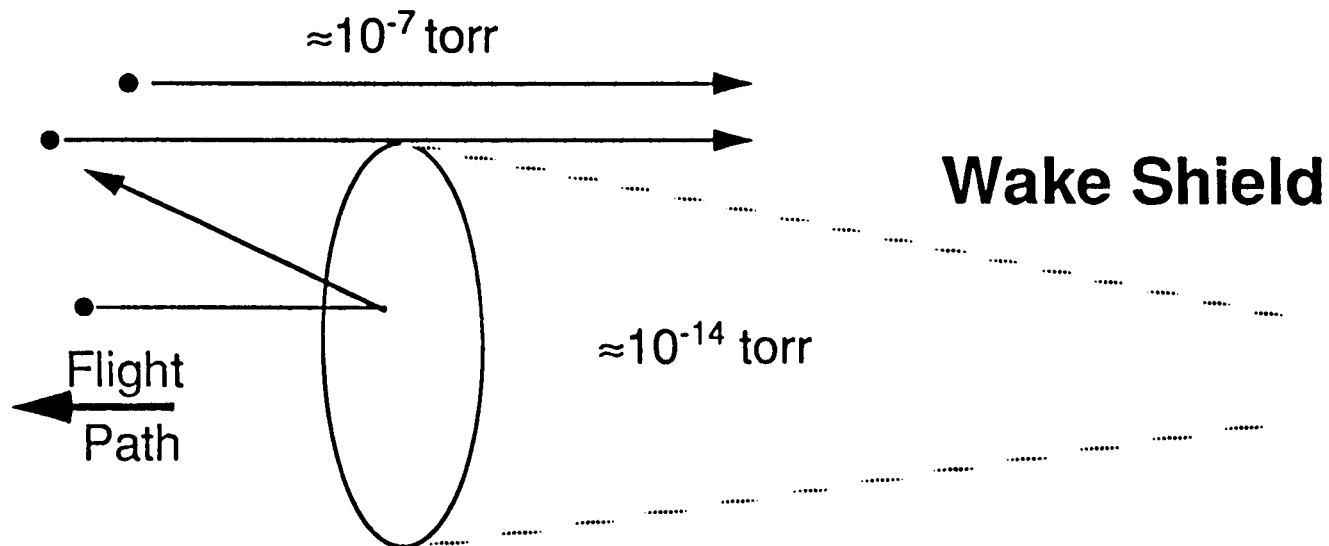
The accomplishment of the objectives of WSF-1 and the three subsequent WSF missions is expected to prove the theory that electronic materials grown in space are of higher quality. The electronics industry's need for high-speed optical and high frequency devices will continue to drive electronics material development and improvement. The ever-increasing use of electronic materials worldwide and the ability to grow them in thin film form in space are expected to give commercial viability to the use of the space "ultra-vacuum" to produce improved and advanced electronic materials.







Ultra-Vacuum in Space for Thin Film Growth



Wake Shield Facility-1 (WSF-1) Overview

Facility	Sponsor	Affiliates	Facility Description	Potential Commercial Applications
Wake Shield Facility (WSF)	Space Vacuum Epitaxy Center*, University of Houston, Houston, Texas	Space Industries, Inc., League City, Texas; American X-tal; Technology, Dublin, Calif.; AT&T Bell Labs, Murray Hill, N.J.; Instruments, S.A., Inc., Edison, N.J.; Ionwerks, Houston, Texas; Quantum Controls, Houston, Texas; Schmidt Instruments, Inc., Houston, Texas	<p>Sensitive vacuum measurement devices aboard the WSF Free Flyer will characterize the "ultra-vacuum" generated by the 12-foot diameter stainless steel disk.</p> <p>Gallium Arsenide (GaAs) thin films will be grown using Molecular Beam Epitaxy (MBE) and Chemical Beam Epitaxy (CBE) to demonstrate the advantages of material processing in the space vacuum environment.</p>	<p>The use of improved GaAs thin film material in electronic components holds a very promising economic advantage.</p> <p>The commercial applications for high quality GaAs devices are most critical in the consumer technology areas of:</p> <ul style="list-style-type: none"> •digital cellular telephones •high-speed transistors and processors •high-definition television(HDTV) •fiber optic communications & •opto-electronics.

WSF-1 Experiments

Facility	Sponsor	Affiliates	Facility Description	Potential Commercial Applications
Charging Hazards and Wake Studies (CHAWS)	Space Vacuum Epitaxy Center*, University of Houston, Houston, Texas	United States Air Force Phillips Laboratory/ Geophysics Directorate, Hanscom Air Force Base, Mass.	CHAWS will measure the charged particle environment in the vicinity of the WSF to complete analysis of the wake's "ultra-vacuum" and investigate the behavior of exposed high potentials in a plasma wake.	This experiment will demonstrate the operation of a unique miniaturized plasma detector and provide data to validate Air Force analytical model for spacecraft charging.
Microgravity Measurement Device (MMD)	SVEC, UH	NASA Johnson Space Center (JSC)	JSC will use the WSF as a testbed for the development of highly sensitive accelerometers (MMD) which measure low levels of acceleration by a vehicle in space, specifically, the microgravity environment of the WSF Free Flyer.	To support the WSF in commercial operations as a free flying space platform.
Plume Impingement Experiment (PIE)	SVEC, UH	NASA JSC)	A complex and extensive series of Shuttle thruster firings will target the WSF during rendezvous, relying on Free Flyer instrumentation to characterize the Shuttle's thruster plumes.	To provide information to space station planners on the complex interaction between Shuttle thruster firings and space structures (such as the space station).

WSF-1 Collaborative Experiments

Facility	Sponsor	Affiliates	Facility Description	Potential Commercial Applications
Materials Laboratory-1 -- MatLab-1	Center for Materials for Space Structure (CMSS)*, Case Western Reserve University, Cleveland, Ohio	Westinghouse-Hanford, Martin Marietta, TRW, Rosemount, 3M, Dow Corning, McDonnell Douglas, NASA Lewis Research Center, Jet Propulsion Laboratory	The MFLEX (Materials FLight EXperiment carrier) will carry the MatLab, housing different materials and coatings on the front of the WSF to determine how they hold up in the space environment.	The results will help to determine which materials to use in construction of products for the space environment (<i>e.g.</i> , rockets, satellites, space station), based on the material's qualities (<i>i.e.</i> , durable, light-weight).
Containerless Coating Process (CONCOP-I)	United States Army Construction Engineering Research Laboratory (CERL), Champaign, Ill.		An investigation of hot filament thin film metals deposition on a variety of materials, conducted in the "Smart Cans" mounted on the Shuttle Cross Bay Carrier (SCBC).	The results will give researchers information about applying metallic and reflective coatings to space structures while in space.

SPACEHAB-2

Evolution of the SPACEHAB Program

The commercial development of space is a NASA objective as directed by legislation and national policy. Through the many facets of its commercial development of space program, NASA has developed and maintains a high level of commitment to this objective. To that end, NASA has actively invested in the continued technological leadership of the United States and its future economic growth through the direct promotion and support of private sector space-related activities.

In the late 1980's, NASA's commercial development of space program identified a significant number of payloads to be flown to further program objectives. To viably sustain this program, the Office of Advanced Concepts and Technology identified a level of flight activity necessary to support the various payload requirements. In September 1989, the office conducted an analysis which revealed that planned Space Shuttle flight activity would not meet middeck-class accommodations needs. Mission experience had already demonstrated the middeck as a very cost-effective area to conduct "crew-tended" scientific and commercial microgravity research. However, the size and number of experiments that can be accommodated in the middeck is severely limited, has conflicting requirements from Shuttle operations and other NASA programs, and is being further constrained by a number of factors such as reduced flight rates.

In order to provide the necessary support for commercial development of space payloads, the Commercial Middeck Augmentation Module (CMAM) procurement was initiated in February 1990, through the Johnson Space Center (JSC). Subsequently, in November 1990, NASA awarded a 5-year contract to SPACEHAB, Inc., of Arlington, Va., for the lease of their pressurized module, the SPACEHAB Space Research Laboratory. This unit provides additional space for "crew-tended" payloads as an extension of the Shuttle orbiter middeck into the Shuttle cargo bay.

This 6-year lease arrangement covers five Shuttle flights and requires SPACEHAB, Inc., to provide for the physical and operational integration of the SPACEHAB Space Research Laboratory into Space Shuttle orbiters, including experiments and integration services, such as safety documentation and crew training.

NASA's primary objective for leasing the SPACEHAB Space Research Laboratory is to support the agency's commercial development of space program by providing access to space to test, demonstrate or evaluate techniques or processes in the environment of space, and thereby reduce operational risks to a level appropriate for commercial development.

NASA's secondary objective in leasing the SPACEHAB Laboratory is to foster the development of space infrastructure which can be marketed by private firms to support commercial microgravity research payloads. It is expected that commercial demand will result from successful demonstrations of SPACEHAB.

The first, and very successful, flight of the SPACEHAB Space Research Laboratory was made on Space Shuttle Mission STS-57, June 21-27, 1993. All systems operated nominally and met 100% of mission success criteria. The 21 NASA-sponsored experiments achieved over 90% of mission success criteria and detailed analyses are underway.

SPACEHAB Laboratory Accommodations

The SPACEHAB Space Research Laboratory is located in the forward end of the Shuttle orbiter cargo bay and is accessed from the orbiter middeck through a tunnel adapter connected to the airlock. It weighs 10,584 pounds, is 9.2 feet long, 11.2 feet high and 13.5 feet in diameter. It increases pressurized experiment space in the Shuttle orbiter by 1100 cubic feet, quadrupling the working and storage volume available. Environmental control of the laboratory's interior maintains ambient temperatures between 65 and 80 degrees Fahrenheit.

The laboratory has a total payload capacity of 3,000 pounds based on operational constraints and, in addition to facilitating crew access, provides the experiments with standard services, such as power, temperature control and command/data functions. Other services, such as late access/early retrieval and vacuum venting also are available.

The SPACEHAB Space Research Laboratory can provide various physical accommodations to users based on size, weight and other user requirements. Experiments are commonly integrated into the laboratory in Shuttle middeck-type lockers or SPACEHAB racks. The laboratory can accommodate up to 61 lockers, with each locker providing a maximum capacity of 60 pounds and 2.0 cubic feet of volume.

The laboratory can also accommodate up to two SPACEHAB racks, either of which can be a "double-rack" or "single-rack" configuration. A "double-rack" provides a maximum capacity of 1250 pounds and 45 cubic feet of volume, whereas a "single-rack" provides half of that capacity. The "double-rack" is similar in size and design to the racks planned for use in the space station.

The use of lockers or racks is not essential for integration into the SPACEHAB Laboratory. Payloads also can be accommodated by directly mounting them in the Laboratory.

Operations Philosophy of the SPACEHAB Program

In order to help keep development costs within levels appropriate to entrepreneurial enterprises, the Office of Advanced Concepts and Technology's (OACT) flight programs accept a certain level of risk in order to approach the payloads from the commercial standpoint, including payload development costs incurred by industry partners. Each of the investigators is aware of and accepts a self-established level of risk for mission success. However, crew and orbiter safety requirements are always fully met.

Some of the payloads associated with this SPACELAB flight are physically located in the orbiter middeck. The middeck space that makes this possible is made available by accommodating in the SPACEHAB module other items such as supplies that are normally stowed in the middeck. This operational approach best provides for the late installation and early retrieval of payloads with time critical requirements such as perishable samples. These payloads remain in the middeck throughout the flight in order to reduce the use of critical on-orbit crew time in moving materials from one location to another. The actual relocation of payloads on-orbit would also introduce undesirable operational risks.

The preparations for the flight of SPACEHAB-2 have included the development of a number of backup and contingency operations for each payload appropriate to that payload's relative design simplicity. These backup procedures include scenarios which might possibly affect crew or orbiter safety, and each payload has procedures associated with it that will deactivate and/or save the payload. Shuttle crew members are trained in the use of these procedures.

The SPACEHAB-2 Payload Complement

The second voyage of the SPACEHAB Space Research Laboratory will contain 12 payloads conducted under the CMAM contract. Like SPACEHAB-1, SPACEHAB-2 payloads represent a wide range of space experimentation including 9 commercial development of space experiments in materials processing and biotechnology, sponsored by five NASA Centers for the Commercial Development of Space (CCDS). There are also three supporting hardware and technology development payloads, one from a CCDS, one from the Lewis Research Center, and one from the Johnson Space Center. One non-NASA experiment is also on this flight. It is attached to the exterior of the module and will collect cosmic dust and debris.

SPACEHAB-2 will carry seven biotechnology experiments. These experiments range from improving drugs to feeding plants, from splitting cells to studying the immune system disorders. Two materials processing experiments use furnaces to study sintering of metals and the growth of crystals by vapor transport. The third concentration of experiments is in supporting hardware, with two payloads designed to obtain data on the low-gravity environment of this SPACEHAB flight, to support data analysis of the other investigations, and to further characterize SPACEHAB as a carrier for microgravity experiments.

The 12th payload will provide a test and demonstration of technology developed by NASA to support space flight activities with refrigerator/freezer capability requirements such as life sciences and biotechnology.

Each of the commercial development of space payloads has been screened by the NASA Office of Advanced Concepts and Technology (OACT) to review the viability of the commercial aspects of the proposed activity as well as the technical soundness. Most of the SPACEHAB-2 payloads have flown on the Shuttle before, with this flight representing the continuation of industry-driven research toward a new or improved commercial end product or process. Some of the CCDS payloads, including the CCDS-sponsored accelerometer, have participated in the NASA OACT Consort series of suborbital sounding rocket flights to test hardware operation and gain flight worthiness.

NASA Centers for the Commercial Development of Space

The Centers for the Commercial Development of Space (CCDS) program is the cornerstone of NASA's commercial development of space activities, generating 10 of the total of 12 flight hardware packages for which NASA is leasing services on the flight of SPACEHAB-2. NASA's nationwide CCDS network represents a unique example of how government, industry and academic institutions can create partnerships that combine resources and talents to strengthen America's industrial competitiveness. The CCDS's are designed to increase private sector participation and investment in commercial space-related activities, while encouraging U.S. economic leadership and stimulating advances in promising areas of research and development. The CCDS's are based at universities and research institutions across the country and benefit from links with their industrial partners, each other and with NASA field centers.

The CCDS's foster industry-driven, space-based, high-technology research in areas such as: materials processing, biotechnology, remote sensing, communications, automation and robotics, and space power.

NASA OACT provides annual funding of up to \$1 million to each center, with additional funding to those centers to cover specific programs or flight activities, as appropriate. NASA offers the CCDS's its scientific and technical expertise through NASA field centers, opportunities for cooperative activities and other forms of continuing assistance. A key facet of the CCDSs is the additional financial and in-kind contributions and capabilities from industry affiliates, state and other government agencies, which, on the average, exceed the NASA funding level.

Through creative and enterprising partnerships with industry, the CCDS program helps move emerging technologies from the laboratory to the marketplace with speed and efficiency. The accomplishments of CCDS participants include significant advances in a number of scientific fields and hundreds of Earth- and space-based applications. As an incubator for future commercial space industries, the CCDS program, since its inception, has facilitated a number of new commercial space ventures and supported a wide range of ongoing efforts.

The CCDS program continues to be the key facilitator for U.S. industry involvement in commercial development of space activities, encouraging and supporting new and ongoing space-related ventures, as well as spawning research and development advancements that promise enormous social and economic benefits for all.

Equipment for Controlled Liquid Phase Sintering Experiments

The Consortium for Materials Development in Space (CMDS) based at the University of Alabama in Huntsville (UAH) has developed the Equipment for Controlled Liquid Phase Sintering Experiments (ECLiPSE). Wyle Laboratories supported the development of ECLiPSE which flew successfully on STS-57 SPACEHAB-01. This furnace was developed in a very rapid and cost-effective manner. ECLiPSE is now available as space-qualified hardware and is a key part of this nation's commercial space infrastructure.

On STS-60, the SPACEHAB-2 ECLiPSE experiment investigates the Liquid Phase Sintering (LPS) of metallic systems. Sintering is a well-characterized process by which metallic powders are consolidated into a metal at temperatures only 50% of that required to melt all of the constituent phases. In LPS, a liquid coexists with the solid, which can produce sedimentation, thus producing materials that lack homogeneity and dimensional stability. To control sedimentation effects, manufacturers limit the volume of the liquid. The ECLiPSE experiment examines metallic composites at or above the liquid volume limit to more fully understand the processes taking place and to produce materials that are dimensionally stable and homogeneous in the absence of gravity.

The ECLiPSE project is focused on composites of hard metals in a tough metal matrix. This composite will have the excellent wearing properties of the hard material and the strength of the tough material. Applications of such a composite include stronger, lighter, more durable metals for bearings, cutting tools, electrical brushes, contact points and irregularly shaped mechanical parts for high stress environments. Kennametal, Inc., is an industry partner of the UAH CMDS participating in the ECLiPSE experiment and has immediate applications for material improvements in the ceramic composites tested. Kennametal, one of the nation's largest cutting tool manufacturers, is developing stronger, more durable tool bits and cutting edges. Other industry partners on the ECLiPSE project are Wyle Laboratories, Automatic Switch Company, Parker Hannifin Corporation, and Machined Ceramics.

Preparation of the ECLIPSE payload begins with the compaction of two or more metal powders under high pressure (11.2 tons/sq. in.) to form a composite. Once compacted, the composites are cleaned and installed into the ECLIPSE high temperature furnace for flight. A Wyle Laboratories-designed Universal Small Experiment Container (USEC) will house the furnace assembly within the SPACEHAB Space Research Laboratory rack. In operation, the ECLIPSE payload is first evacuated, pressurized with argon gas and switched on by the crew. The furnace then autonomously heats to a temperature in excess of 2000°F, which is above the melting point of one of the metals in the composite samples. The samples then undergo the rearrangement and solution re-precipitation stages of LPS. The hardware performs purge, heat-up, processing, quench and cool down cycles. The total time for all operations is slightly more than 10 hours.

ECLIPSE is mounted in a SPACEHAB single rack. During on-orbit operations, a crew member monitors the indicators on the front of the payload to show the health of the hardware and progress of the experiment through the operating cycles. Once the unit has completed all cycles, a crew member connects a Payload General Support Computer (PGSC) to the ECLIPSE, downloads the data stored inside the ECLIPSE process control computer and then shuts down the experiment. The Shuttle flight of the ECLIPSE payload is building on the experience of other ECLIPSE flights on suborbital rockets. Suborbital flights have provided 1-3 minutes of sample processing time and now the longer flight durations possible on the Shuttle are required. Because the hardware was originally designed to fly in suborbital rockets, it is very automated, requiring little crew interaction.

Principal Investigator for ECLIPSE is Dr. James E. Smith, Jr., Associate Professor and Chairman, Department of Chemical and Materials Engineering, The University of Alabama in Huntsville.

Space Experiment Furnace

The Space Experiment Furnace (SEF) is a space flight furnace system managed by the Consortium for Materials Development in Space (CMDS) based at the University of Alabama in Huntsville (UAH). The SEF was manufactured by Boeing Commercial Space Development Company, Seattle, WA, and is similar to Boeing's Crystals by Vapor Transport Experiment (CVTE) furnace which flew in October 1992 on STS-52.

The initial objective of the SEF project was to provide a vapor transport crystal growth furnace for use by the CCDS's. The SEF system has the capability to carry one, two or three separate furnaces at one time and has room for two samples in each furnace, for a total of up to six samples. The CVTE was designed as a middeck facility while the SEF has been adapted for flight in the SPACEHAB Space Research Laboratory and is mounted in a SPACEHAB single rack. This is the first flight of the SEF.

The SEF has two transparent furnaces available for operations at various temperatures up to approximately 900°C, but only one of these will be flown and used aboard SPACEHAB-2. The third furnace has an opaque core design that allows it to reach temperatures up to 1080°C to satisfy higher temperature requirements.

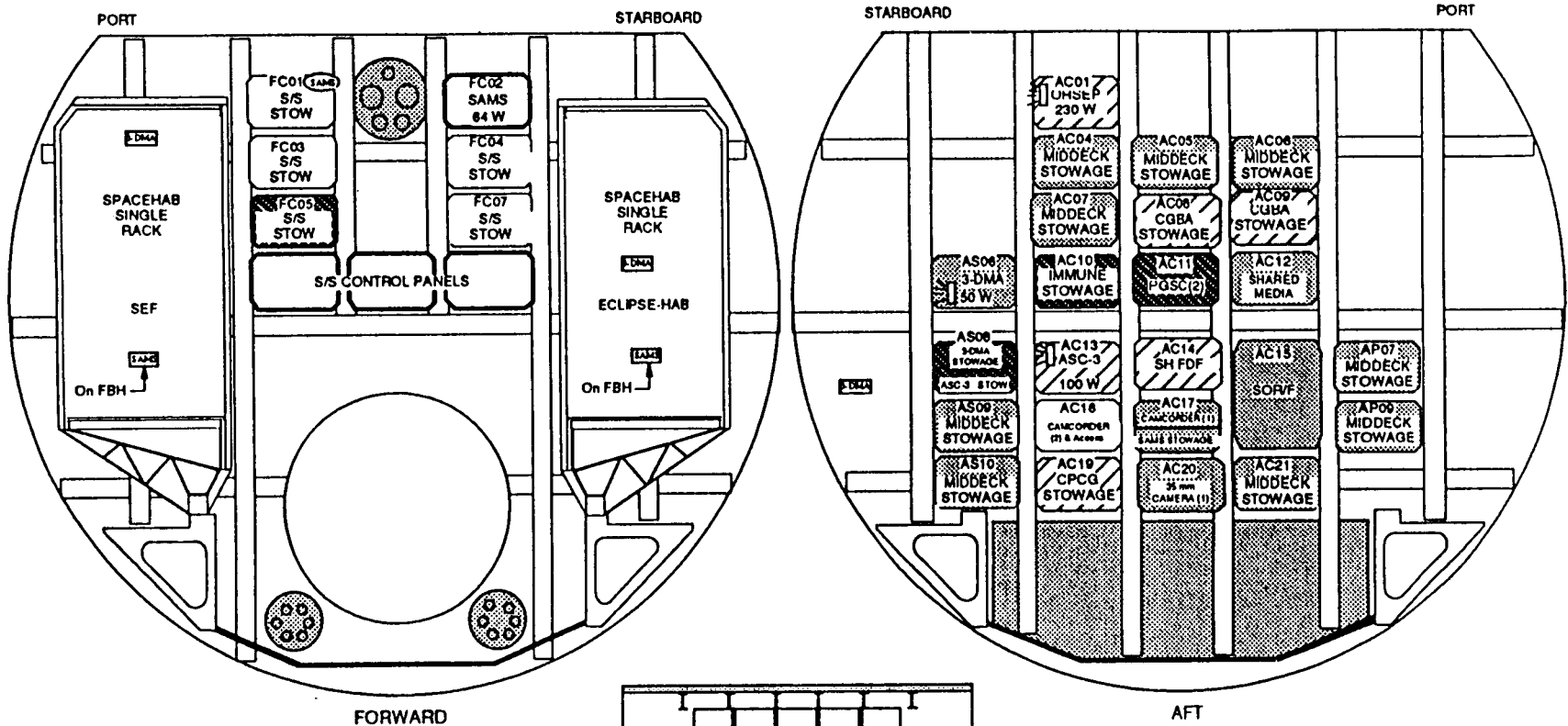
The SEF differs from UAH's other furnace, ECLiPSE, in several ways. First, the SEF can process different types of crystals, notably crystals grown from vapor. Second, the furnace will process the samples in transparent ampoules that can be monitored by the crew and adjusted to optimize crystal growth. Third, the sample ampoules can be translated within the furnace to control the applied temperature gradients. And, fourth, while the opaque furnace can be used for metal and alloy processes, such as liquid metal sintering, it can provide temperature gradients as compared to the isothermal characteristics of ECLiPSE.

Thus, although the original CVTE furnace was designed to process crystals, SEF operations are not being restricted to crystal growth. For instance, on SPACEHAB-2, UAH will be using the opaque core for its Sintered and Alloyed Materials project. The Consortium for Commercial Crystal Growth at Clarkson University, another CCDS, will use a transparent furnace for growth of Cadmium Telluride crystals using vapor transport techniques.

The industry affiliates involved in designing, fabricating, and integrating the SEF for SPACEHAB-2 flight are: Boeing Commercial Space Development Company, Seattle, WA; McDonnell Douglas Aerospace - Huntsville, Huntsville, AL; and Wyle Laboratories, Huntsville, AL.

The Principal Investigator for the UAH/CMDs Sintered and Alloyed Materials project which will use the opaque core furnace in the SEF for SPACEHAB-2 is Dr. James E. Smith, Jr., Associate Professor and Chairman, Department of Chemical and Materials Engineering, The University of Alabama in Huntsville. Dr. Smith is also the P.I. of the ECLiPSE furnace experiment which will be flying on SPACEHAB-2. The Principal Investigator for the Clarkson-sponsored Cadmium Telluride activity is Professor Herbert Wiedemeier of Rensselaer Polytechnic Institute.

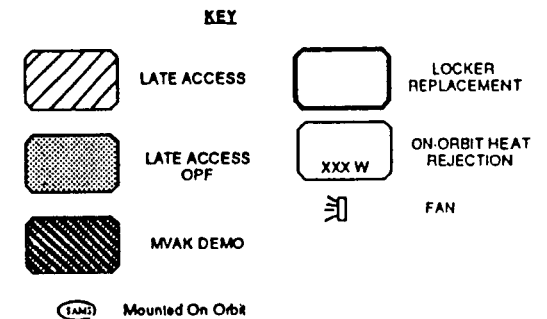
SPACEHAB 02 MODULE LAYOUT



NOTE: The following are located in Orbiter middeck:

- CPCG(2)
- CGBA(3)
- PSB
- IMMUNE(2)
- BPL

SRE is located on top of the module



ASTROCULTURE™

The ASTROCULTURE™ payload is sponsored by the Wisconsin Center for Space Automation and Robotics (WCSAR), a NASA Center for the Commercial Development of Space (CCDS), located at the University of Wisconsin in Madison.

Extended space ventures that involve human presence will require safe and reliable life support at a reasonable cost. Plants play a vital role in the life support system we have here on Earth. Likewise, we can expect that plants will be a critically important part of a life support system in space because they can be a source of food while providing a means of purifying air and water for humans. Currently, no satisfactory plant-growing unit is available to support long-term plant growth in space. Several industry affiliates including Automated Agriculture Assoc., Inc., Dodgeville, WI; Biotronics Technologies, Inc., Waukesha, WI; Orbital Technologies Corp., Madison, WI; and Quantum Devices, Inc., Barneveld, WI, together with WCSAR have embarked on a cooperative program to develop the technologies needed for growing plants in a space environment.

The objective of the ASTROCULTURE™ (ASC) series of flight experiments is to validate the performance of plant growth technologies in the microgravity environment of space. Each of the flight experiments will involve the incremental addition of important subsystems required to provide the necessary environmental control for plant growth. The flight hardware is based on commercially available components, thereby significantly reducing the cost of the hardware. The information from these flight experiments will become the basis for developing large scale plant growing units required in a life support system. In addition, these technologies will also have extensive uses on Earth, such as improved dehumidification/humidification units, water-efficient irrigation systems, and energy-efficient lighting systems for plant growth.

The ASC-1 flight experiment, conducted during the USML-1 mission on STS-50, evaluated the WCSAR concept for providing water and nutrients to plants. The ASC-2 flight experiment, conducted during the SPACEHAB-01 mission on STS-57, provided additional data on the water and nutrient delivery concept, plus an evaluation of the light emitting diode (LED) based plant lighting concept. Results from both these flight experiments indicate that all the goals were achieved and confirmed the validity of these concepts for use in space-based plant growing unit.

The ASTROCULTURE™ (ASC-3) flight experiment included in the SPACEHAB-2 mission is designed to validate a WCSAR developed concept for controlling temperature and humidity in a closed air loop of the plant growth chamber. This unit is capable of both humidifying and dehumidifying the air and does not require a gas/liquid separator for recovery of the condensed water as do all other systems now being used for dehumidification in space. This condensed water can be used as a source of cooking and drinking water. Demonstration of the successful performance in space of this humidity and temperature control technology will represent a major advance in our ability to provide superior environmental control for plant growth in an inexpensive and reliable space flight package.

The flight hardware for this mission is accommodated in a SPACEHAB locker located in the module and weighs approximately 50 pounds. The ASC-3 flight unit includes the water and nutrient delivery unit, the LED-based plant lighting unit, the temperature and humidity control unit, and a microprocessor unit for control and data acquisition functions. These subsystems, or units, provide essentially all the environmental regulation needed for plant growth. It is expected that the next ASC flight experiment beyond SPACEHAB-2 will include plants as a test of the operational effectiveness of the units to support plant growth.

The Principal Investigator on ASTROCULTURE™ is Dr. Raymond J. Bula, WCSAR.

Penn State Biomodule

The Penn State Biomodule (PSB) payload will test the hypothesis that exposure to near zero gravity (microgravity) can alter microbial gene expression in commercially useful ways. The payload was developed by the Center for Cell Research (CCR), a NASA CCDS based at The Pennsylvania State University, and its commercial partner, Novo Nordisk Entotech, Inc. Novo Nordisk Entotech, Inc., is located in Davis, California, and is part of Denmark-based Novo Nordisk A/S, a global company with diverse business anchored primarily in biotechnology, serving the health care, industrial and agricultural sectors.

Novo Nordisk Entotech develops bioinsecticides, naturally occurring microbes that produce products that are toxic to certain insects, but are non-toxic to non-target pests, people and the environment. The company is interested in determining if exposure to microgravity can enhance microbial expression, altering the growth, toxin production and potency of these environmentally friendly pest-control agents.

The microbes scheduled to be tested aboard STS-60, *Bacillus thuringiensis* var. *tenebrionis*, are known to be specifically effective against the Colorado potato beetle. They will be carried in the Penn State Biomodule which is being used for the first time aboard the Shuttle. The biomodule is a computer-controlled, fluid-transfer, mixing device developed by the Center for Cell Research. It was flight tested and developed aboard the Consort sounding rocket series.

Eight Biomodules, each containing eight microbial samples, will be housed in a sealed containment vessel within a Commercial Refrigeration/Incubation Module (CRIM) located in the middeck. The containment vessel was also designed and developed by the Center for Cell Research in conjunction with Commercial Payloads, Inc., of St. Louis, MO.

In its STS-60 configuration, the Biomodule needs no hands-on attention from the astronauts. The device automatically provides dynamic temperature regulation, three levels of liquid containment and the ability to add two different fluids to each sample at different time intervals during the spaceflight.

To accelerate postflight data analyses, the CCR has developed a gel encapsulation procedure for bacteria that enables quick, efficient, automated, identification of microbes that display altered patterns of gene expression. In this technique, individual bacteria are trapped inside tiny (30 micron) gel beads. Using fluorescent markers and a flow cytometer, the researchers can quantify bacterial growth and product formation within each individual bead. In this way, altered bacteria that over- or under-produce insect toxins can be quickly identified, isolated and cultured as part of the postflight analysis.

CCR scientific affiliates Dr. Zane Smilowitz, Penn State professor of entomology, and Dr. William McCarthy, Penn State associate professor of entomology, are co-principal investigators. Penn State graduate student Bryan Severyn, an M.S. candidate in entomology, is assisting them. Dr. Chi-Li Liu, Manager of Microbiology, is Entotech's representative. Dr. William W. Wilfinger is CCR Director of Physiological Testing and principal investigator on the gel encapsulation project. Dr. W. C. Hymer is Director of the Center for Cell Research. Dr. Pamela Marrone is President of Novo Nordisk Entotech, Inc.

BioServe Pilot Laboratory

The BioServe Pilot Laboratory (BPL) is sponsored by BioServe Space Technologies, a NASA Center for the Commercial Development of Space (CCDS) based at the University of Colorado in Boulder.

The BPL will play an important role in providing the commercial and scientific communities affordable access to space for material and life sciences research. The main focus of the project is to provide a "first step" opportunity to companies interested in exploring materials processing and life science experiments in space. The notion behind the project is to allow industry a mechanism for entry level "proof of concept" flights. Thus, the BPL is a crucial screening device for more complex, targeted space research and development activities.

The BPL payload has been designed to support investigations in a wide variety of life sciences areas with primary emphasis on cellular studies. Following a successful flight on STS-57 SPACEHAB-01, this second BPL flight on SPACEHAB-2 consists of investigations on bacterial products and processes.

One investigation examines *Rhizobium trifolii* behavior in microgravity. Rhizobia are special bacteria that form a symbiotic relationship with certain plants. The bacteria infect the plants early in seedling development to form nodules on the plant roots. The bacteria in these nodules derive nutritional support from the plant while in turn providing the plant with nitrogen fixed from the air. Plants that form such relationships with rhizobia are called legumes and include alfalfa, clover and soybean. Such plants do not require synthetic fertilizers to grow. In contrast, many important crop plants such as wheat and corn are dependent on synthetic fertilizers since they do not form symbiotic relationships with rhizobia.

The experimental system employing *Rhizobium trifolii* is a model that can be used to better understand the multi-step process associated with rhizobia infection of legumes. Once understood, it may become possible to manipulate the process to cause infection of other crop plants. The potential savings in fertilizer production would be tremendous.

One of the commercial goals of the BioServe Center is to determine whether microgravity might be exploited as a tool for rhizobial infection of significant crop plants. This BPL investigation along with complementary investigations in BioServe's Commercial Generic Bioprocessing Apparatus (CGBA) also flying in the SPACEHAB Space Research Laboratory should provide data needed to address this goal.

Another investigation being flown in the BPL concerns bacteria.

E. Coli. These bacteria are normally found in the gastrointestinal tracts of mammals, including humans. *E. Coli* have been well studied as a model system for bacterial infection and population dynamics and in genetics research. With regard to commercial application, the genetic material in *E. Coli* has been manipulated to produce bacteria capable of secreting important pharmaceutical products. These bacteria also serve as a model for bacteria used in waste treatment and water reclamation.

For STS-60, these bacteria are being studied to determine changes in growth and behavior that occur as a consequence of exposure to microgravity. The commercial objectives for this investigation include understanding and controlling bacterial infection in closed environments, exploiting bacteria and other micro-organisms in the development of ecological life support systems and waste management, and determining the opportunity for enhanced genetic engineering and enhanced pharmaceutical production using bacterial systems.

Yet another BPL investigation examines a biomedical test model based on cells derived from frog kidney. This investigation is intended to provide insight into effects of microgravity on cell behavior -- especially cell division. Gravitational effects on such cell systems may be used as models of diseases or disorders that occur on Earth. For STS-60, the kidney cell system is being examined to determine feasibility for use as such a test model.

On STS-60, the BPL will consist of 40 Bioprocessing Modules (BPMs) stowed in a standard middeck locker. The BPMs will contain the biological sample materials. The stowage locker will also contain an Ambient Temperature Recorder (ATR) which will provide a temperature history of the payload throughout the mission.

Each BPM consists of three syringes held together on an aluminum tray. Generally, the center syringe in each BPM will be loaded with the cell culture system. Adjacent syringes will contain process initiation and termination fluids, respectively. A three-way valve is mounted on the trays which permits fluid transfer from one syringe to the next. The syringes, valve tubing and fittings provide for containment of the sample materials. The hardware is further enclosed in heat-sealed plastic bags to provide additional levels of containment.

Some of the BPMs will be fitted with a special filter at the front of the center syringe. This filter allows fluids, but not cells, to pass in and out of the center syringe. With these special BPMs, products secreted by the cells under study can be separated from the cells on orbit and preserved, without the need for a fixative that would damage the secreted products.

Approximately 26 hours after reaching orbit, a crew member will initiate the various investigations within the BPMs. Typically, this is done by removing each BPM from stowage, turning the three-way valve and pushing a syringe plunger to transfer the initiation solution into the center syringe.

The BPMs will be terminated at predetermined time points throughout the mission. Similar to initiation, the three-way valve is turned and the plunger on the center syringe is pushed to transfer cell materials into the termination solution. In some instances, only part of the contents of the center syringe will be transferred. This will effectively produce two samples for analysis, one that is terminated and another that continues to develop during the balance of operations.

For most of the investigations, simultaneous ground controls will be run. Using similar hardware and identical sample fluids, ground personnel will activate and terminate BPMs in parallel with the flight crew. Synchronization will be accomplished based on voice downlink from the crew. Ground controls will be conducted at the SPACEHAB Payload Processing Facility at Cape Canaveral, Fla.

After the orbiter has landed, the stowage locker containing the BPMs will be turned over to BioServe personnel for deintegration. Some sample processing will be performed at the landing site. However, most BPMs will be shipped or hand-carried back to the sponsoring laboratories for detailed analysis.

Dr. Marvin Luttges, Director of the BioServe CCDS, is Program Manager. Drs. Louis Stodieck and Michael Robinson, also of BioServe, are responsible for mission management.

Commercial Generic Bioprocessing Apparatus

The Commercial Generic Bioprocessing Apparatus (CGBA) payload is sponsored by BioServe Space Technologies, a NASA Center for the Commercial Development of Space (CCDS), located at the University of Colorado, Boulder. The purpose of the CGBA is to allow a wide variety of sophisticated biomaterials, life sciences and biotechnology investigations to be performed in one device in the low gravity environment of space.

During the STS-60 mission, the CGBA will support 32 separate commercial investigations, which can be classified in three application areas: biomedical testing and drug development, controlled ecological life support system (CELSS) development and agricultural development and manufacture of biological-based materials. These areas and investigations are shown in the following three tables.

Biomedical Testing and Drug Development -- To collect information on how microgravity affects biological organisms, the CGBA will include twelve biomedical test models. Of the twelve test models, four are related to immune disorders: one will investigate the process in which certain cells engulf and destroy foreign materials (phagocytosis); another will study bone marrow cell cultures; two others will study the ability of the immune system to respond to infectious-type materials (lymphocyte and T-cell induction); and one will investigate the ability of immune cells to kill infectious cells (TNF-Mediated Cytotoxicity).

The other eight test models -- Which are related to bone and developmental disorders, toxicological wound healing, cancer and cellular disorders -- will investigate bone tissue, miniature wasp development testing, brine shrimp development, inhibition of cell division processes, stimulation of cell division processes and the ability of protein channels to pass materials through cell membranes.

Test model results will provide information to better understand diseases and disorders that affect human health, including cancer, osteoporosis and AIDS. In the future, these models may be used for the development and testing of new drugs to treat these diseases.

Closed Agricultural Systems Development -- To gain knowledge on how microgravity affects micro-organisms, small animal systems, algae and higher plant life, the CGBA will include 11 ecological test systems. One of the test systems will examine miniature wasp development. Five separate studies will concern seed germination and seedling processes related to CELSS development. Another four test systems will investigate bacterial products and processes and bacterial colonies for waste management applications. Finally, another system will study new materials to control build-up of unwanted bacteria and other micro-organisms.

Test system results will provide research information with many commercial applications. For example, evaluating higher plant growth in microgravity could lead to new commercial opportunities in controlled agriculture applications. Test systems that alter micro-organisms or animal cells to produce important pharmaceuticals could later be returned to Earth for large-scale production. Similarly, it may be possible to manipulate agricultural materials to produce valuable seed stocks.

Biomaterials Products and Processes -- The CGBA also will be used to investigate nine different biomaterials products and processes. Two investigations will attempt to grow large protein and RNA crystals to yield information for use in commercial drug development. A third investigation will evaluate the assembly of virus shells for use in a commercially-developed drug delivery system. Two other investigations will use fibrin clot materials and collagen as a model of potentially implantable materials that could be developed commercially as replacements for skin, tendons, blood vessels and even cornea. Three investigations will focus on drug development. One will be using plant tissue cultures to create the anti-cancer drug taxol. The second will be looking at the bacteria E. Coli and its resistance to drugs in microgravity. The third investigation will be looking at yeast reproduction as a drug production process.

Results from the 32 investigations will be carefully considered in determining subsequent steps toward commercialization. STS-60 marks the fourth of six CGBA flights. Future flights will continue to focus on selecting and developing investigations that show the greatest commercial potential.

The CGBA consists of 432 Fluids Processing Apparatuses (FPAs) packaged in 54 Group Activation Packs (GAPs). Each GAP will house eight FPAs. The FPAs will contain biological sample materials which are mixed on-orbit to begin and end an experiment. Individual experiments will use two to 24 FPAs each. 192 FPAs in 24 GAPs will be stored in the SPACEHAB Space Research Laboratory in two standard stowage lockers; these samples are less time critical than the others with regard to installation or retrieval. 240 FPAs in 30 GAPs will be stored on the middeck of the orbiter in 3 standard stowage lockers or locker equivalents. 144 FPAs will be kept at a temperature of 37°C throughout the mission, while 288 FPAs will be kept at ambient temperature. Those lockers containing FPA at ambient temperature will also contain ambient temperature records (ATRs) which will provide a temperature history of the payload throughout the mission.

Fluids Processing Apparatus (FPA) -- Sample materials are contained inside a glass barrel that has rubber stoppers to separate three chambers. For each investigation, the chambers will contain precursor, initiation and termination fluids, respectively. The loaded glass barrel will be assembled into a plastic sheath that protects the glass from breakage and serves as a second level of sample fluid containment.

The FPAs are operated by a plunger mechanism that will be depressed on-orbit, causing the chambers of precursor fluid and the stoppers to move forward inside the glass barrel. When a specific stopper reaches an indentation in the glass barrel, initiation fluid from the second chamber is injected into the first chamber, activating the biological process.

Once processing is complete, the plunger will again be depressed until the termination fluid in the third chamber is injected across the bypass in the glass barrel into the first chamber.

Group Activation Packs (GAP) -- The GAP consists of a 4-inch diameter plastic cylinder and two aluminum endcaps. Eight FPAs will be contained around the inside circumference of the GAP cylinder. A crank mechanism extends into one end of the GAP and attaches to a metal pressure plate. By rotating the crank, the plate will advance and depress the eight FPA plungers simultaneously, significantly facilitating crew handling of the FPAs.

Upon reaching orbit, the crew will initiate the various investigations by attaching a crank handle to each GAP. Turning the crank will cause an internal plate to advance and push the plungers on the contained FPAs. This action, in turn, causes the fluids in the forward chambers of each FPA to mix. Most of the GAPs will be activated on the second flight day.

The crew will terminate the investigations in a manner similar to activation. Attaching and turning the GAP crank will cause further depression of the FPA plungers which will cause the fluid in the rear chamber to mix with the processed biological materials. This fluid will typically stop the process or "fix" the sample for return to Earth in a preserved state. Each of the 54 GAPs will be terminated at different time points during the mission. In this manner, sample materials can be processed from as little as one hour to nearly the whole mission duration.

For most of the investigations, simultaneous ground controls will be run. Using identical hardware and samples fluids and materials, ground personnel will activate and terminate FPAs in parallel with the flight crew. Synchronization will be accomplished based on indications from the crew as to when specific GAPs are operated. A temperature-controlled environment at the SPACEHAB Payload Processing Facility (SPPF), Cape Canaveral, Fla., will be used to duplicate flight conditions.

After the orbiter has landed, the stowage lockers will be retrieved and turned over to BioServe personnel for deintegration. Some sample processing will be performed at the SPPF; however, most FPAs will be shipped or hand-carried back to the sponsoring laboratories for detailed analysis.

Dr. Marvin Luttges, Director of the BioServe CCDS, is program manager for CGBA. Drs. Louis Stodieck and Michael Robinson, also of BioServe, are responsible for mission management.

SPACEHAB-2 COMMERCIAL GENERIC BIOPROCESSING APPARATUS INVESTIGATIONS

Biomedical Testing and Drug Development

These investigations will provide information to develop a better understanding of diseases and disorders that affect human health including cancer, osteoporosis and AIDS. These models may be used for the development and testing of new drugs to treat these diseases.

Commercial Opportunity	PI Affiliation	Process/Product Development	Experiment Description
Immune Disorders	University of Alabama, Huntsville	Lymphocyte Induction Process	Examines immune system's ability to respond to infectious-type materials.
	Kansas State University	T-Cell Induction Test Model	Examines immune system's ability to respond to infectious-type materials.
		TNF-Mediated Cytotoxicity Test Model	Examines immune cells' ability to kill infectious cells.
		Bone Marrow Cell Culture Test System	Studies bone marrow cultures in microgravity.
Bone Disorders	Kansas State University	Bone Organ Culture Test Model	Studies the effects of microgravity on bone development.
Development Disorders	Kansas State University	Pancreas and Lung Development Tests	Examines organ development in microgravity.
		Brine Shrimp Test System	Examines brine shrimp development in microgravity.
Cancer	Kansas State University	Inhibitor Protein Test Model	Studies inhibition of cell division processes.
Cellular Disorders	Kansas State University	Gap Junction Processes	Investigates ability of protein channels to pass materials through cell membranes.
	University of Colorado	Cell Division Processes	Studies stimulation of cell division processes.
Toxicological Testing	Kansas State University	Brine Shrimp Test System Model	Examine ability of brine shrimp to be used for toxicity tests.
	University of Colorado	Miniature Wasp Test System Model	Examine ability of miniature wasps to be used for toxicity tests.

Ecological Test Systems

These investigations could lead to new commercial opportunities in controlled agriculture applications, large scale production on Earth of important pharmaceuticals, and production of valuable seed stocks by manipulation of agricultural materials.

Commercial Opportunity	PI Affiliation	Process/Product Development	Experiment Description
Closed Agriculture Systems	University of Colorado	Seed Germination Products	Studies seed germination in microgravity.
	Kansas State University	Seedling Processes	Examines seeding processes in microgravity.
	University of Colorado	Miniature Wasp Test System	Investigates miniature wasp development in microgravity.
	Kansas State University	Bacterial Nitrogen Fixation Model	Studies important symbiotic relationships between bacteria and plants.
	University of Colorado	Plant Tissue Culture Processes	Studies secondary metabolic production during spaceflight.
	University of Colorado	Plant Bacterial Infection Processes	Studies important symbiotic relationships between bacteria and plants.
Waste Management	University of Colorado	Bacterial Products and Processes	Studies bacterial products and processes in microgravity.
	Kansas State University	Bacterial Products and Processes	Studies bacterial products and processes in microgravity.
	Kansas State University	Bacterial Products and Processes	Studies important symbiotic relationships between bacteria and plants.
	University of Colorado	Bacterial Colony Test System	Studies bacterial colony products and processes in microgravity.
Microbial Controls	Kansas State University	Zirconium Peroxide Product Testing	Examines effectiveness of Zirconium Peroxide as a decontaminant.

Biomaterials Products and Processes

Potential applications of these investigations include commercial drug development and a drug delivery system, and the development of potentially implantable materials used commercially as replacements for skin, tendons, blood vessels and cornea.

Commercial Opportunity	PI Affiliation	Process/Product Development	Experiment Description
Drug Delivery System	Kansas State University	Virus Capsid Product	Evaluates assembly of virus shells.
Drug Development	University of Colorado	Protein Crystal Morphology Products	Growth of large protein crystals.
		RNA Crystal Growth Products	Growth of large RNA crystals.
Data Mass Storage	Syracuse University	Bacteriorhodopsin Biomatrix Products	Formation of more homogeneous bacteriorhodopsin gels for use as mass data storage devices.
Synthetic Implants	University of Colorado	Fibrin Clot Materials	Use of fibrin clot materials as a model of potentially implantable materials.
		Collagen Materials	Use of collagen as a model of potentially implantable materials.
Pharmaceutical Development	University of Colorado	Taxol Culture Model	Investigates the production of taxol in microgravity.
Drug Development	University of Colorado	Bacterial Drug Resistance	Investigates the effects of microgravity on drug resistance.
		Yeast Reproduction	Investigates the use of yeast as drug producers.

SPACEHAB-2 COMMERCIAL BIOTECHNOLOGY EXPERIMENTS OVERVIEW

Experiment	Sponsor	Affiliates	Experiment Description	Potential Commercial Applications
ASTROCULTURE TM	Wisconsin Center for Space Automation and Robotics, Madison, Wis. (CCDS)	Automated Agriculture Assoc., Inc., Biotronics, Technologies, Inc., Quantum Devices, Inc., Orbital Technologies Corp.	Validates technologies for supplying water and nutrients to plants growing in microgravity and providing a controlled environment.	Development of an enclosed environmental system with earth-based and space-based uses, including improved dehumidification/humidification and energy efficient lighting.
Penn State Biomodule	Center for Cell Research (CCR), St. College, Pa. (CCDS)	Novo Nordisk Entotech, Inc.	The Biomodule is a computer-controlled, fluid-transfer, mixing device. The microbes studied in the biomodule are specifically effective on the Colorado Potato Beetle.	Improvement of environmentally friendly pest-control agents.
BioServe Pilot Laboratory (BPL)	BioServe Space Technologies, Boulder, Colorado (CCDS)	Abbot Labs, Alza, Aquatic Products, Chiron, Martin Marietta, Spaceport Florida Authority, Synchrocell	Determines the response of cells to various hormones and stimulating agents in microgravity.	Development of next-generation drugs and space-grown polymers.
Commercial Generic Bioprocessing Apparatus (CGBA)	BioServe Space Technologies, Boulder, Colorado (CCDS)	Abbot Labs, Aquatic Products, Chiron, Martin Marietta, OmniData, Spaceport Florida Authority, Synchrocell, Water Technologies	Processes biological fluids by mixing components in a microgravity environment.	Improvement of bio-implantable products, immune disease research and waste management systems.
IMMUNE	BioServe Space Technologies, Boulder, Colorado (CCDS)	Chiron Corporation	The IMMUNE-1 experiment is a study of 12 rats. The drug PEG-IL2 will be used in an attempt to alleviate the immunosuppression induced by the environment.	The experiment may provide a new therapy to treat the effects of spaceflight on the human immune system, as well as on physiological systems effected by the immune system.
Organic Separation (ORSEP)	Consortium for Materials Development in Space, Huntsville, Ala. (CCDS)	Interfacial Dynamics Corp. Space Hardware Optimization Technology, Inc.	Explores the use of phase separation techniques in microgravity conditions to separate cells, cell fragments and heavy molecules.	Improvement of techniques for processing pharmaceutical and biotechnology products.

Commercial Protein Crystal Growth (CPCG)	Center for Macromolecular Crystallography, Birmingham, Ala. (CCDS)	Medical Foundation of Buffalo	Growth of high quality protein crystals in microgravity using temperature as the primary controlling factor in crystallization; one of the two systems flying uses laser light scattering techniques to monitor crystallization for enhanced control.	Acceleration or enabling of drug research and development using or requiring crystallography to determine molecular structure.
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SPACEHAB-2 SUPPORTING HARDWARE OVERVIEW

Hardware	Sponsor	Hardware Operation	Potential Applications
3-Dimensional Microgravity Accelerometer (3-DMA)	Consortium for Materials Development in Space, Huntsville, Ala. (CCDS)	Measures accelerations in three axes within the SPACEHAB to record the microgravity levels experienced during the flight.	Characterization of low-gravity environment of the SPACEHAB Space Research Laboratory, and the acquisition of acceleration data to support experiment data analysis.
Space Acceleration Measurement System (SAMS)	NASA Lewis Research Center, Cleveland, Ohio		Two different systems are flown to satisfy different program objectives and to correlate the data obtained by the two systems. This also allows the comparison of such data with that gathered on other flights where only one or the other system has flown.

SPACEHAB-2 TECHNOLOGY DEVELOPMENT OVERVIEW

Hardware	Sponsor	Hardware Operation	Potential Applications
Stirling Orbiter Refrigerator Freezer (SOR/F)	NASA Johnson Space Center, Houston, Tex.	Flight test and characterization of advanced refrigerator freezer technology in microgravity	Enhanced refrigerator/freezer capability to support biotechnology, life sciences, and other investigations on orbit.

SPACEHAB-2 COMMERCIAL MATERIALS PROCESSING EXPERIMENTS OVERVIEW

Experiment	Sponsor	Affiliates	Experiment Description	Potential Commercial Applications
Equipment for Controlled Liquid Phase Sintering Experiment- (ECLIPSE)	Consortium for Materials Development in Space, Huntsville, Ala. (CCDS)	Wyle Laboratories Kennametal, Inc.	Uses a rack-mounted, enclosed furnace assembly to investigate controlled liquid phase sintering of metallic systems in microgravity.	Development of stronger, lighter and more durable bearings, cutting tools, electrical contact points, and irregularly shaped parts for high stress environments.
Space Experiment Furnace (SEF)	Consortium for Materials Development in Space, Huntsville, Ala. (CCDS)	Boeing Commercial Space Development Company McDonnell Douglas Aerospace	The SEF allows up to three separate furnaces in one unit. This flight will carry one transparent furnace and one opaque core furnace.	The opaque furnace will be used for a Sintered and Alloyed materials project. The transparent furnaces will be used by the Clarkson CCDS for Cadmium-Telluride crystal growth.

IMMUNE-1

The IMMUNE-1 experiment is a middeck payload sponsored by BioServe Space Technologies. BioServe is a NASA Center for the Commercial Development of Space (CCDS) at the University of Colorado, Boulder, and Kansas State University, Manhattan. The corporate affiliate leading the IMMUNE-1 investigation is Chiron Corporation, Emeryville, Calif., with NASA's Ames Research Center, Mountain View, Calif., providing payload and mission integration support.

The goal of IMMUNE-1 is to reduce or prevent the changes seen in the immune system of rats after space flight. The experiment may provide a new therapy to treat the effects of space flight on the human immune system, as well as on physiological systems affected by the immune system.

Hardware for the IMMUNE-1 experiment consists of two Commercial Animal Enclosure Modules (CAEMs). The CAEM is a copy of the Animal Enclosure Module (AEM) developed by the Ames Research Center. The CAEM provides life support for the rats.

IMMUNE-1 is the second experiment to use the CAEM in support of activities to develop the commercial uses of space. (The first was the Physiological Systems Experiment, conducted with the Center for Cell Research, another NASA CCDS.) The AEM has a considerable successful flight history in support of other NASA investigations.

Each of the two CAEMs in the Shuttle's middeck area will hold six rats. Six of the rats will be treated pre-flight with a prescribed dosage of a compound similar to the commercially available recombinant Interleukin-2, which is known to stimulate the immune system. The compound used in IMMUNE-1 -- polyethylene glycol-modified recombinant human Interleukin-2 (PEG-IL-2) -- is longer-lasting than recombinant Interleukin-2. It will be used in an attempt to reduce or prevent the suppression of the immune system seen in rats flown in space. The other six rats will receive a placebo.

The rats will live in an environment similar to that of the astronauts in terms of launch stress, length of exposure to microgravity, and the forces of Shuttle re-entry and recovery. These conditions are known to result in a suppression of the immune system similar to "shipping fever" in cattle. The utility of PEG-IL-2 in preventing spaceflight-induced effects on the immune system may lead to its use as a therapeutic treatment for shipping fever in animals on Earth.

The longer-lasting PEG-IL-2 probably will be useful in clinical settings in which patients could receive less frequent injections, perhaps once a week instead of up to three times a day, as is necessary with recombinant IL-2. The development of recombinant IL-2 for treatment of some human cancers is still being investigated, although it is licensed for high-dose therapy of kidney cancer in humans.

Based on recent experimental findings, PEG-IL-2 (and recombinant IL-2) appears to have potential as an antiviral, as well as an antibacterial, agent. As such, PEG-IL-2 may become a part of a therapy used to treat various opportunistic infections associated with AIDS and other non-AIDS related infectious diseases.

It also may become part of a standard treatment for the nation's aging population, because aging individuals demonstrate decreased levels of Interleukin-2. The PEG-IL-2 treatment could accompany flu shots to bolster the immune system of the elderly. These important applications present exciting commercial opportunities for Chiron Corp.

The science team will be led by principal investigator Dr. Robert Zimmerman of Chiron Corp. Co-principal investigators are Drs. Marvin Luttges and Keith Chapes of BioServe and Dr. Gerald Sonnenfield of the Carolinas Medical Center, Charlotte, N.C. Other investigators include Drs. Richard Gerren, Steven Simske and Louis Stodieck, BioServe; Ed Miller, Harrington Cancer Center/Texas Tech University, Amarillo, Texas; and Jason Armstrong and Mary Fleet, BioServe.

Organic Separations

The Consortium for Materials Development in Space (CMDS) based at the University of Alabama in Huntsville has developed the Organic Separations (ORSEP) payload for flight on STS-60.

ORSEP offers the commercial and scientific communities the opportunity to separate cells and particles based on their surface properties using a process known as counter current phase partitioning. Such separations cannot be carried to equilibrium on Earth because sedimentation influences the separation before partitioning equilibrium can be established. It is hoped that equilibrium separations will produce subpopulations with nearly identical surface properties rather than with some contamination of surface and density that is presently the case with Earth-based users. The potential commercial value of separations includes the opportunity to identify subpopulations, to study the purified samples and to culture cell subpopulations for cell product.

The ORSEP hardware was built by Space Hardware Optimization Technology (SHOT), Inc. Floyd Knobs, Ind. It is considerably lower cost than existing phase partitioning devices, and SHOT may be able to capture a good portion of the commercial market on Earth. The hardware is a modular design which can be configured for use with Shuttle middeck, Spacelab, the SPACEHAB Space Research Laboratory, and sounding rockets. On this flight, ORSEP will be accommodated in a standard-sized locker located in the module.

It is a multi-sample, multi-step, fully automated device that separates non-biological particles, as well as biological cells, particles, macromolecular assemblies and organelles in low gravity via partitioning in liquid polymer two-phase systems. The hardware has been designed to perform partitioning in microgravity for a long duration because two to three hours are required for each separation step. Commercial interests were factored into the hardware design in its multi-sample capability that offers temperature control and sterility. On STS-60, the SPACEHAB Space Research Laboratory makes available continuous power, which allows for constant heating/cooling for the experiment while the vacuum of space provides thermal insulation. As a result of these design features, four samples can be processed through 12 steps while being held at selected temperatures in a sterile environment.

The samples that will be processed on STS-60 in the ORSEP apparatus include growth hormone vesicles supplied by the Penn State Center for Cell Research along with inert particles for equilibration and diagnostics. On STS-60, a new use for the ORSEP hardware as a low-gravity cell culturing facility will be demonstrated. The ability of the ORSEP hardware to mix a culture medium with various activators and fixture agents in a controlled manner offers several unique advantages over other flight-qualified cell culturing hardware. Lymphocytes and bone-marrow cells will be provided by Dr. Marian Lewis at UAH. ORSEP has flown on 9 prior Shuttle missions and two suborbital flights as a part of its development. The UAH CMDS plans to continue development of ORSEP on additional suborbital rocket flights and SPACEHAB missions.

ORSEP is designed to be capable of fully-automated operations but it relies on crew interaction to maximize its results. Full function digital display and interaction controls allow the crew to monitor and control the vacuum which will modify the temperature of the experiment. The crew can also control both the initiation and operation of the four experiments which provide for potential variations in mission operations. The next planned generation of ORSEP is to be designed for use on space station. New samples in sterile cassette devices will be launched in the Shuttle.

The principal investigator of ORSEP is Dr. Robert J. Naumann, University of Alabama in Huntsville.

Commercial Protein Crystal Growth

The Center for Macromolecular Crystallography (CMC), based at the University of Alabama in Birmingham (UAB), is sponsoring Commercial Protein Crystal Growth (CPCG) experiments on STS-60. The CMC is a NASA Center for the Commercial Development of Space (CCDS), which forms a bridge between NASA and private industry to stimulate biotechnology research for growing protein crystals in space and offers other protein crystallography services to a wide range of pharmaceutical, chemical and biotechnology companies.

The objective of space-based protein crystal growth experiments on STS-60 SPACEHAB-2 is to produce large, well-ordered crystals of various proteins. These crystals are to be used in ground-based studies to determine the three-dimensional structures of the proteins. These experiments also continue to investigate how to control and optimize protein crystal growth in order to reduce uncertainties or risks associated with using this space-based process as a

vital and enabling technology for many critical areas. The SPACEHAB-01 protein crystal growth experiments were extremely successful. Three of the seven proteins flown produced superior data when compared to the very best crystals ever obtained by Earth-grown methods using any other method of crystallization.

The technique most-widely used to determine a protein's three-dimensional structure is X-ray crystallography, which requires large, well-ordered crystals for analysis. Crystals produced on Earth often are large enough to study, but they usually have numerous gravity-induced flaws. However, space-produced crystals tend to have more highly-ordered structures that significantly facilitate X-ray diffraction studies.

Since proteins play an important role in everyday life -- from providing nourishment to fighting diseases -- research in this area is quickly becoming a viable commercial industry. Scientists need large, well-ordered crystals to study the structure of a protein and to learn how its structure determines a protein's functions.

Studies of such crystals not only can provide information on basic biological processes, but they may lead to the development of food with higher protein content, the production of highly resistant crops and, of great importance, the development of more effective drugs. By studying the growth rates of crystals under different conditions, scientists can find ways to improve crystal growth in microgravity, thus providing higher-quality crystals for study and the ability to produce satisfactory protein crystals that are hard or impossible to grow on Earth. For these reasons, the CMC will have conducted protein crystal growth experiments on 19 Shuttle missions after completion of STS-60.

Crystallization Facility Experiments

The CPCG experiments are contained in two thermal control enclosures called Commercial Refrigerator/Incubator Modules (CRIM) both located in the middeck. Each CRIM contains a Protein Crystallization Facility (PCF), and one has been modified with a light scattering (LS) system and is called PCFLS.

The PCF has been successful in inducing crystallization of human insulin by lowering the temperature of one end of a cylindrical crystallization chamber from 40°C to 22°C over a period of 24 hours. Since the rest of the chamber takes time to match the temperature of the controlled end, the crystals are formed within a temperature gradient.

The light scattering system is designed to detect crystals at the nucleation stage, before they would be visible by ordinary microscopy. The information is to be used to alert the astronauts of initial crystal formation. After they know that crystals have formed they will decrease the rate at which the temperature of the controlled end is changing. This will allow the crystals that have formed to grow more slowly and more perfectly in the weightlessness of space.

The light scattering system consists of a laser beam from a laser diode delivered into the sample chamber and a photo detector viewing the beam from an angle of 30°. As the protein molecules begin to collect into small nuclei, they become larger, hence more efficient,

scattering particles, and the laser beam becomes brighter. This principle is demonstrated when large dust particles appear brighter than small ones in a sunbeam shining through a household window. The increased brightness is seen by the detector, and the information is sent to a Macintosh Powerbook computer. This information is graphed on the screen of the Powerbook for the astronauts to view.

The computer evaluates the scattering information and has an alarm that alerts the astronauts of crystal formation, but the astronauts must still evaluate the scattering curve to confirm that nucleation has actually occurred before modifying the rate of temperature change. Human insulin is the protein to be crystallized in this flight of the PCFLS system.

Due to each protein's short lifetime and the crystals' resulting instability, the protein crystal growth experiments will be retrieved within 3 hours of the Shuttle landing and will be returned to the CMC for post-flight analyses. This early retrieval is made possible by the quick access to the SPACEHAB laboratory after landing.

The CMC has flown over 50 different types of proteins in space, seeking protein structure data and techniques for predictable enhancement by growth in microgravity. Crystallographic analysis has revealed that on average 20% of proteins grown in space are superior to their Earth-grown counterparts. As a result of advances made by the CMC in its microgravity crystallographic technologies, 40% of the proteins flown on the first United States Microgravity Laboratory (USML-1) mission in July 1992, yielded diffraction size crystals, several of which were superior to any previously grown on Earth.

With continued research, the commercial applications developed using protein crystal growth have phenomenal potential, and the number of proteins that need study exceeds tens of thousands. Current research with the aid of pharmaceutical companies may lead to a whole new generation of drugs, which could be able to help treat diseases such as cancer, rheumatoid arthritis, periodontal disease, influenza, septic shock, emphysema, aging and AIDS. These possibilities plus drugs and other products for agriculture, proteins for bioprocessing in manufacturing processes and waste management, and other biotechnical applications, represent critical capabilities for dealing with the future of our world.

A number of companies are participating in the CMC's protein crystal growth projects including: BioCryst Pharmaceuticals, Inc., Eli Lilly & Co., Schering-Plough Research, Du Pont Merck Pharmaceuticals, Sterling Winthrop Inc., Eastman Kodak Co., The Upjohn Co., Smith Kline Beecham Pharmaceuticals, and Vertex Pharmaceuticals, Inc. Principal Investigator for the STS-60 protein crystal growth experiments is Dr. Charles E. Bugg, Director of the CMC.

Three-Dimensional Microgravity Accelerometer

The Consortium for Materials Development in Space (CMDS), is sponsoring the Three-Dimensional Microgravity Accelerometer (3-DMA) on the STS-60 mission. The CMDS is a NASA Center for the Commercial Development of Space (CCDS) based at the University of Alabama in Huntsville (UAH).

The acceleration measurements system will help chart the effects of deviations of zero gravity on the experiments conducted in space. The microgravity environment inside the SPACEHAB Space Research Laboratory will be measured in three dimensions by the 3-DMA at different locations, allowing researchers to review experiment results against deviations from zero gravity. This information will be used to determine the degree of microgravity achieved inside the SPACEHAB Space Research Laboratory. 3-DMA will measure disturbances caused by operating various experiments in SPACEHAB and the residual microgravity resulting from orbiter rotational motions and by the resistance of extreme upper atmosphere fringes. The 3-DMA experiment was successful on the SPACEHAB-01 STS-57 flight; all twelve accelerometers situated at four different locations worked well and continuously generated data. All data desired for the technology development were obtained.

The 3-DMA hardware consists of four accelerometer assemblies to be located in different parts of the SPACEHAB Space Research Laboratory. The accelerometer package is comprised of three remotely located standard three-dimensional systems and three new invertible accelerometers in the central unit. The signal processing system and the new, unique invertible feature permit measurements of absolute microgravity and low-level, quasi-steady, residual accelerations. Those extremely low frequency disturbances are particularly detrimental to space processes such as crystal growth and have proven difficult to measure in the past. The accelerometers provide the acceleration data to a central control unit located in a single locker. The data are recorded in flight on three two-gigabyte magnetic hard drive devices.

A potential application of 3-DMA would be to characterize the microgravity environment of space station in support of experiments, research and commercialization activities. Principal Investigator for 3-DMA is Jan Bijvoet of the UAH CMDS.

Space Acceleration Measurement System

NASA's Microgravity Science and Applications Division at the Lewis Research Center is sponsoring the Space Acceleration Measurement System (SAMS) on the STS-60 mission. The SAMS is designed to measure and record low-level accelerations during experiment operations. The signals from these sensors are amplified, filtered and converted to digital data before being stored on optical disks and sent via downlink to the ground control center. SAMS has flown successfully on seven previous Shuttle flights and acquired nearly 15 gigabytes of data which represents 50 days of operation. Approximately two gigabytes of data will be acquired on the SPACEHAB-2 mission.

The capacity of SAMS' double-sided optical disk used on Shuttle missions is 400 megabytes. This compares to approximately 400 high density floppy disks, or forty standard boxes of ten disks. All the data will fit on one optical disk measuring about 5 inches square.

Three sensors will be flown. One sensor will measure the disturbances near an Environmental Control Support System. Another sensor will be located on the support structure of the SPACEHAB Space Research Laboratory. The third sensor will be attached to a locker door to determine the level of disturbances experienced by experiments in the locker and nearby. Data from all three sensors will be used to further characterize the SPACEHAB Space Research Laboratory microgravity environment. SAMS data will be compared with data from the Three-Dimensional Microgravity Accelerometer (3-DMA.)

Scientists may use the SAMS data in different ways, depending on the nature of the science experiment and the principal investigators' experience and ground-based testing results. The principal investigators will typically look for acceleration events or conditions that exceed a threshold where the experiment results could be affected. This may be, for example, a frequency versus amplitude condition, an energy content condition or simply an acceleration magnitude threshold. Data from previous missions were used to characterize the Shuttle middeck and Spacelab microgravity environment, including disturbances caused by thruster firings and crew exercise with the treadmill and bicycle ergometer.

SAMS flight hardware was designed and developed in-house by the NASA Lewis Research Center. Ronald Sicker is the SAMS Project Manager and Richard Delombard is responsible for analyzing SAMS data.

The flight of the Stirling Orbiter Refrigerator/Freezer (SOR/F) on SPACEHAB-2 is a demonstration to obtain necessary information and characterization about the operation of Stirling refrigerator/freezer technology in microgravity. If proven successful, this technology will be targeted to replace the current vapor compression systems, which historically have had marginal reliability and lower theoretical efficiencies.

The Stirling system in the SOR/F uses environmentally benign helium as a working fluid, has an easily variable capacity, a quick chill capacity, long life gas bearings, and a motor hermetically sealed within the fluid loop, thus avoiding leakage.

Refrigerator/freezer technology for support of on-orbit investigations has been identified by the NASA Office of Life and Microgravity Sciences and Applications, the SOR/F sponsor, as one of its highest priority technologies for development. Since microgravity operation of the SOR/F Stirling unit has not been proven on orbit, this flight test requirement was established as a requirement before the unit can become operational.

SOR/F is a system the size of two standard lockers and was developed under the auspices of the Life Sciences Project Division at the Johnson Space Center. It weighs a total of nearly 100 pounds (97.8 kilograms) and consumes 50 watts of electricity at refrigerator conditions and 70 watts at freezer conditions, with cold set points ranging from -22°C to +10°C. The volume within the refrigerator/freezer unit is slightly less than one cubic foot.

SAMPLE RETURN EXPERIMENT

Principal Investigator: Peter Tsou, Jet Propulsion Laboratory
Coinvestigator: Donald E. Brownie, University of Washington

The Sample Return Experiment sits on top of the Spacehab Module poised to capture intact cosmic dust particles as they come in contact with the 160 capture cells. The capture cells consist of transparent silica aerogel with a density of 0.02/ g/cm³. Silica aerogel is the lowest density known solid material and has extremely fine structure, about 50A.

Cosmic dust particles come from other planetary bodies, remnants of the formation of our solar system, or materials of other stellar systems. Capturing them allows detailed laboratory studies needed to gain understanding of their composition, type of cosmic processing and even the age. The information will contribute to answering the questions pertaining to the origin and development of our solar system and life itself. Along with the cosmic dust, space debris and other hypervelocity materials will be captured to provide detailed tracing of the sources of these other particles as well.

GET AWAY SPECIAL (GAS) PAYLOADS

STS-60 is especially significant to the Get Away Special (GAS) program because Discovery will fly the 100th GAS payload since the program's inception. NASA began flying small self-contained payloads in 1982. The program, managed by the Goddard Space Flight Center (GSFC), Greenbelt, Md., fully utilizes the Shuttle's capacity not used by major payloads. It affords the average person a chance to perform small experiments in space. The program enhances education with hands-on space research opportunities and generates new activities unique to space. Customers also are able to inexpensively test ideas that could later grow into major space experiments.

The first GAS payload reservation was purchased by R. Gilbert Moore. Moore enthusiastically advocated the GAS program throughout aerospace circles. Soon, others began depositing money for GAS payload reservations. When Moore, a Martin Thiokol Corporation executive, donated the first GAS payload to Utah State University (USU), he presented USU students with a new world of hands-on space research.

USU's first payload was very ambitious. Students put ten experiments into a 5 cubic-foot (.14 cubic-meter) GAS container. One experiment grew successive generations of fruit flies to see if microgravity would affect their genetic structure. Other tests examined the effects of microgravity on epoxy resin-graphite composite curing, brine shrimp genetics, duckweed root growth, soldering, homogeneous alloy formation, surface tension, growth rate of algae, and thermal conductivity of a water and oil mixture.

From this first payload a scholarship program emerged in which undergraduate students could design and build experiments to be flown in GAS payloads. Students have since generated payloads totaling numerous experiments, while assisting other universities and institutions with their GAS projects.

Since the program's early days, the GAS team at Goddard have relied on numerous NASA and contractor personnel at the Johnson and Kennedy Space Centers. Without their active support, GAS payloads never would have left the ground. GAS team members at Johnson helped establish simplified integration, operational, and safety documentation procedures. Personnel at Kennedy streamlined techniques and procedures for processing payloads from arrival at Kennedy to installation in the orbiters and from their postflight removal to their shipment back to the experimenters. As well, Kennedy team members found a home for the GAS program on Cape Canaveral.

An unusual feature of the GAS program is that experimenters are not required to furnish postflight reports to NASA. NASA feels that GAS customers can best speak for their own experiments. The payloads results can be reviewed in detail by obtaining papers presented by the experimenters at NASA's Get Away Special Experimenter's Symposiums.

To date, 97 payloads have flown on 19 Shuttle missions. STS-60 will fly four GAS experiments as well as three other payloads on the GAS bridge. Clarke Prouty is GAS Mission Manager and Lawrence R. Thomas is Customer Support Manager for the Shuttle Small Payloads Project at Goddard. The following is a brief description of the payloads that will fly on Discovery:

G-071 The Orbiter Ball Bearing Experiment

Customer: California State University, Northridge
Customer Manager: Joan Yazejian
NASA Technical Manager: Dave Peters

A team of researchers from California State University, Northridge, have built an experiment apparatus called the OBBEX (Orbital Ball Bearing Experiment), to test the effects of melting cylindrical metal pellets in microgravity. If successful, this experiment may produce a new kind of ball bearing, which has never before been built.

One of the goals of the OBBEX experiment is to create the world's first seamless, hollow ball bearing. The hollow characteristic of the ball can improve the service-life rating of a ball bearing. This permits higher speeds and higher load applications, and may reduce the friction encountered in normal operation.

The OBBEX is a self-contained package that provides its own energy needs and is controlled by an on-board computer. The system will be activated by one of the Space Shuttle's crew members at a pre-determined time during the flight, starting with a 90-minute process to melt several metal alloy pellets.

G-514 The Orbiter Stability Experiment

Customer: Dr. Werner Neupert
Customer Manager: James Houston
NASA Technical Manager: Charlie Knapp

The primary scientific objective of this experiment is to measure the vibration spectrum of the orbiter structure that is present during normal orbiter and crew operations. The information received as a result of this measurement is valuable for any fine-pointed optical instrument mounted in the orbiter bay, as even small orbiter disturbances, such as those that may result from normal crew activity, could have an impact on the line-of-sight stability of sensitive optical systems. The net effect is that the vibration spectrum acts as a low level acceleration spectrum that may influence experiments requiring a low gravity environment.

This primary experiment consists of rapid and accurate measurements of the direction of the Sun while the orbiter is oriented with the bay (-Z axis) pointed to the center of the Sun with a nominal deadband. It also measures the effects of exposure to space environment on over-the-counter medicines and plant seeds.

Piggy-backing on this experiment are: Morgan State University, Baltimore, Md., Howard University, Washington, D.C., and native-American high school students from South Dakota. They are participants in the Scientific Knowledge for Indian Learning and Leadership (SKILL) program.

G-536 The Pool Boiling Experiment

Customer: NASA Headquarters, Office of Space Science and Applications,
Microgravity Sciences Division, Washington, D.C.

Customer Manager: Warren Hodges

NASA Technical Manager: Tom Dixon, GSFC

The Pool Boiling Experiment marks the 100th GAS payload to fly since the program's inception. The objective of this experiment is to improve the understanding of the boiling process in microgravity. This involves putting a pool of liquid in contact with a surface that can supply heat to the liquid. The experiment will observe heating and vapor bubble dynamics associated with bubble growth/collapse and subsequent bubble motion. The lack of gravity driven motion makes the boiling process easier to study in microgravity.

This will be the third flight of this payload. The two previous flights have been extremely successful. The data in each flight have been used to improve the science return on the next flight.

G-557 The Capillary Pumped Loop Experiment

Customer: The European Space Agency, The Netherlands

Customer Manager: Dr. G. Reibaldi

NASA Technical Manager: Rich Hoffman

This experiment gives an in-orbit demonstration of the working principle and performances of a two-phase Capillary Pumped Loop (CPL), a two-phase Vapor Quality Sensor, and a two-phase multi-channel Condenser Profile. It also compares data on CPL behavior in a low-gravity environment with analytical predictions resulting from modeling and on-Earth performance.

The Capillary Pumped Loop (CAPL)

The CAPL payload is sponsored by the Goddard Space Flight Center Earth Observing System project and will fly as a Hitchhiker payload on the Space Shuttle. The CAPL experiment will provide a microgravity test of a full sized prototype for a capillary pumped thermal control system. This two-phase system utilizes an ammonia working fluid to transfer large amounts of heat over long distances at nearly constant temperature. Capillary pumped systems will be used for thermal control on Earth Observing System satellites and other future missions.

Orbital Debris Radar Calibration Spheres (ODERACS)

ODERACS is a project of the Space Sciences Branch of the Solar System Exploration Division at the Johnson Space Center, Houston, Texas and NASA Headquarters, Washington, D.C. This experiment deploys six spheres of three different sizes from the orbiter payload bay. The spheres range in size from two to six inches in diameter (five to 15.2 centimeters). The spheres will be observed, tracked, and recorded by ground-based radars and optical telescopes. ODERACS enables end-to-end calibration of the radar facilities and data analysis systems. This calibration is particularly geared toward the small debris size range. Additionally, ODERACS enables the correlation of controlled empirical optical and radar debris signatures to the spheres which have physical dimensions, compositions, albedos, and electromagnetic scattering properties.

The University of Bremen Satellite (BREMSAT)

BREMSAT is a 140 lb (63 kilogram) small satellite built by the University of Bremen's Center of Applied Space Technology and Microgravity (ZARM) under sponsorship of the German Space Agency (DARA). This 480 mm (19 inch) deployable satellite is contained in a GAS canister with a Standard Door Assembly and a modified GAS Carrier Ejection System. BREMSAT performs the following scientific activities at various mission phases before and after satellite deployment:

- Measures heat conductivity.

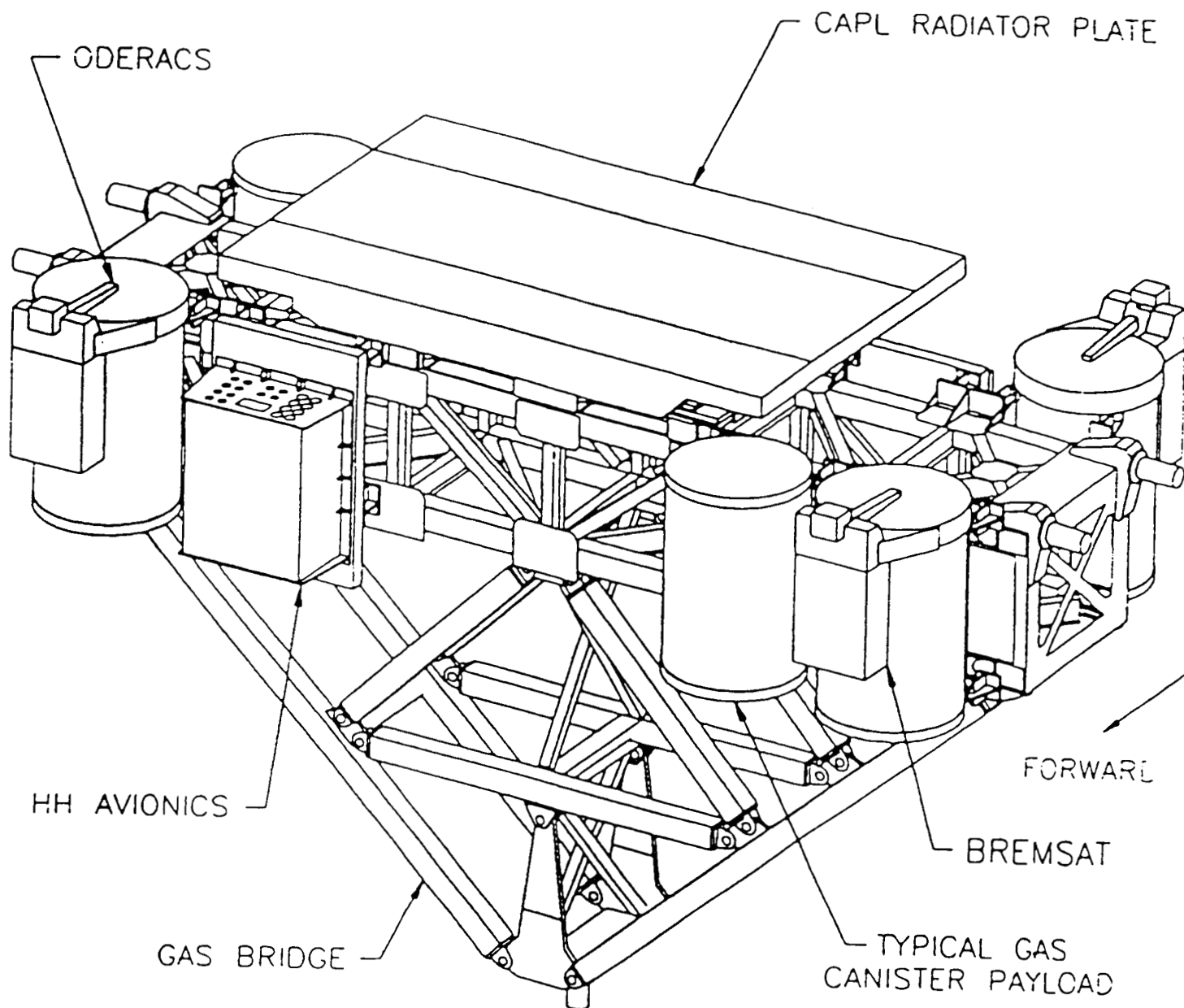
- Measures residual acceleration forces by acceleration sensors to estimate the in-orbit microgravity quality onboard BREMSAT.

- Investigates the density distribution and dynamics of micrometeorites and dust particles in low-Earth orbit.

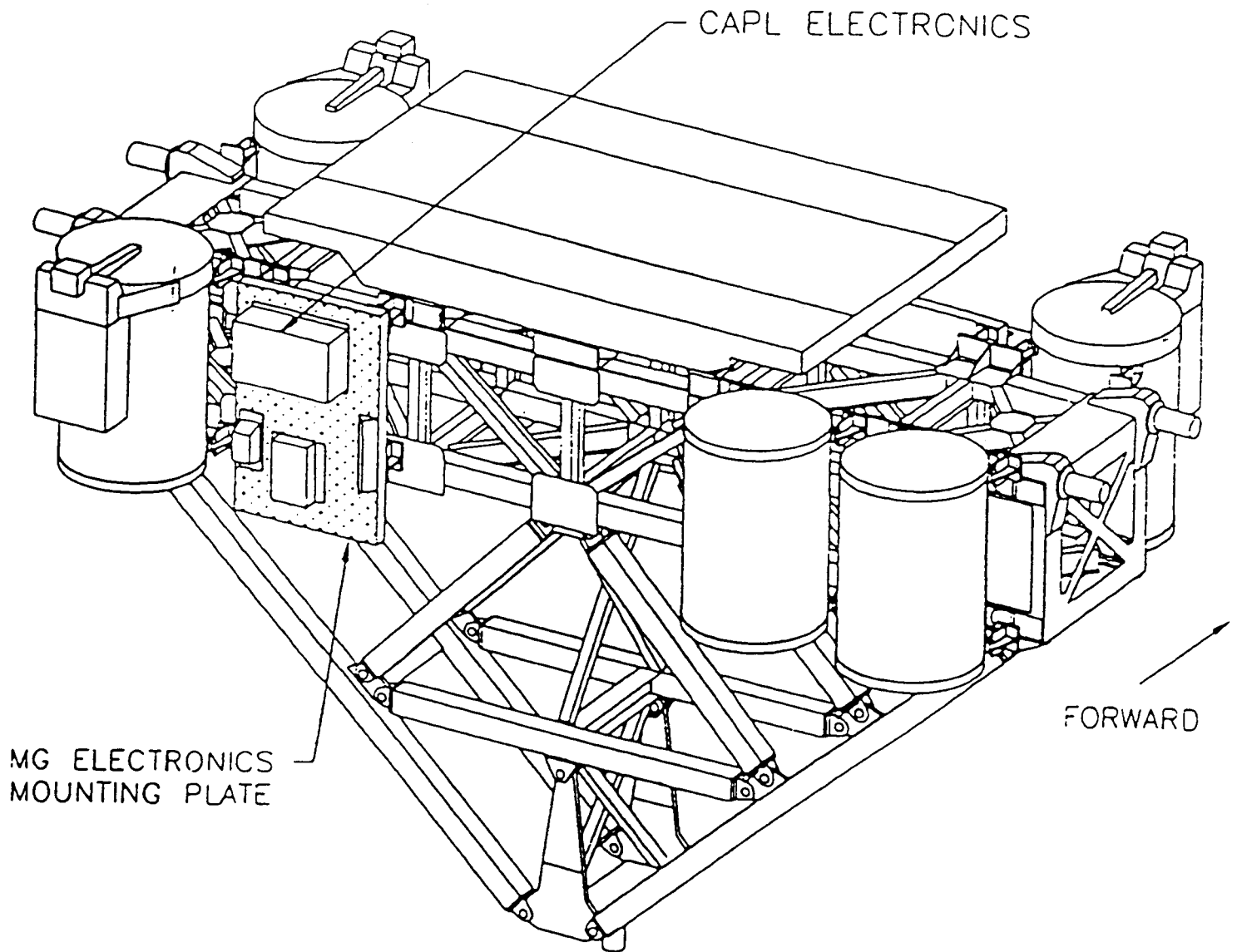
- Maps atomic oxygen.

- Measures the exchange of momentum and energy between the molecular flow and the rotating satellite.

- Measures pressure and temperature during satellite re-entry.



CAPL/GBA/ODERACS/BREMSAT
PAYLOAD CONFIGURATION
(Forward Face)



CAPL/GBA/ODERACS/BREMSAT
PAYLOAD CONFIGURATION
(Aft Face)

Shuttle Amateur Radio EXperiment (SAREX)

Students in the U.S. and Russia will have a chance to speak via amateur radio with astronauts aboard the Space Shuttle Discovery during STS-60. Ground-based amateur radio operators ("hams") will be able to contact the Shuttle through automated computer-to-computer amateur (packet) radio link. There also will be voice contacts with the general ham community as time permits.

Shuttle commander Charles Bolden (license pending) and mission specialists Ronald Sega (license pending) and Sergei K. Krikalev (call sign U5MIR) will talk with students in 5 schools in the U.S. and Russia using "ham radio."

Students in the following schools will have the opportunity to talk directly with orbiting astronauts for approximately 4 to 8 minutes:

- * Boise Senior High School, Boise, Idaho (WA7QKD)
- * Chariton High School, Chariton, Iowa (KB0IWE)
- * James Bean School, Sidney, Maine (N1IFP)
- * Mars Area Middle School, Mars, Penn (N3HKN)
- * House of Science and Technology for Youth, Central Moscow, Russia (UA3CR)

The radio contacts are part of the SAREX (Shuttle Amateur Radio EXperiment) project, a joint effort by NASA, the American Radio Relay League (ARRL), and the Radio Amateur Satellite Corporation (AMSAT).

The project, which has flown on 11 previous Shuttle missions, is designed to encourage public participation in the space program and support the conduct of educational initiatives through a program to demonstrate the effectiveness of communications between the Shuttle and low-cost ground stations using amateur radio voice and digital techniques.

Information about orbital elements, contact times, frequencies and crew operating schedules will be available during the mission from NASA, ARRL (Steve Mansfield, 203/666-1541) and AMSAT (Frank Bauer, 301/ 286-8496). AMSAT will provide information bulletins for interested parties on INTERNET and amateur packet radio.

The ham radio club at the Johnson Space Center, (W5RRR), will be operating on amateur short wave frequencies, and the ARRL station (W1AW) will include SAREX information in its regular voice and teletype bulletins.

There will be a SAREX information desk during the mission in the Johnson Space Center newsroom. Mission information will be available on the computer bulletin board (BBS). To reach the bulletin board, use JSC BBS (8 N 1 1200 baud): dial 713-483-2500, then type 62511.

The amateur radio station at the Goddard Space Flight Center, (WA3NAN), will operate around the clock during the mission, providing SAREX information and retransmitting live Shuttle air-to-ground audio.

STS-60 SAREX Frequencies

Routine SAREX transmissions from the Space Shuttle may be monitored on a worldwide downlink frequency of 145.55 MHz.

The voice uplink frequencies are (except Europe):

144.91 MHz
144.93
144.95
144.97
144.99

The voice uplink frequencies for Europe only are:

144.70
144.75
144.80

Note: The astronauts will not favor any one of the above frequencies. Therefore, the ability to talk with an astronaut depends on selecting one of the above frequencies chosen by the astronaut.

The worldwide amateur packet frequencies are:

Packet downlink	145.55 MHz
Packet uplink	144.49 MHz

The Goddard Space Flight Center amateur radio club planned HF operating frequencies:

3.860 MHz	7.185 MHz
14.295	21.395
28.650	

- end -

AURORAL PHOTOGRAPHY EXPERIMENT (APE-B)

The objectives of the Auroral Photography Experiment-B (APE-B) is to obtain spectral images of orbiter thruster emissions, Shuttle glow, air glow and auroral glow. This will be accomplished by photographing these phenomena with the on board CCTV cameras and recording the information on two video cassettes.

Still photos will be taken with a spectrometer assembly consisting of a 35mm camera, intensifier assembly, 55mm lens, clamp and spectrometer section. The experiment will be operated by the flight crew at pre-determined times throughout the mission.

CREW BIOGRAPHIES

Charles F. Bolden, 47, Col., USMC, is the commander (CDR) of STS-60. A native of Columbia, S.C., Bolden was selected as an astronaut in 1980 and will be making his third Space Shuttle flight.

Bolden graduated from C.A. Johnson High School in Columbia in 1964; received a bachelor's degree in electrical science from the Naval Academy in 1968; and received a master's in systems management from the University of Southern California in 1977.

After flying more than 100 sorties in Vietnam as a Marine Corps aviator, Bolden graduated from the Naval Test Pilot School in 1979. Following his selection by NASA, Bolden's first flight was as pilot of Shuttle mission STS-61C in January 1986. His second flight was as pilot of Shuttle mission STS-31 in April 1990, and his third flight was as commander of STS-45 in March 1992. His technical assignments with NASA have included service as a Special Assistant to the Johnson Space Center Director in Houston and as an Assistant Deputy Administrator at NASA Headquarters in Washington, D.C.

Bolden has logged more than 481 hours in space.

Kenneth S. Reightler, Jr., 42, Capt., USN, is the pilot (PLT) of STS-60. Selected as an astronaut in 1987, Reightler considers Virginia Beach, Va., his hometown and will be making his second space flight.

Reightler graduated from Bayside High School in Virginia Beach in 1969; received a bachelor's degree in aerospace engineering from the Naval Academy in 1973; received a master's in aeronautical engineering from the Naval Postgraduate School in 1984; and received a master's in systems management from the University of Southern California in 1984.

As a Naval aviator, Reightler attended the Naval Test Pilot School in 1978, and, following service as a test pilot for a variety of Naval aircraft, later was serving as chief instructor at the test pilot school when selected by NASA. His first Shuttle flight was as pilot of STS-48 in September 1991. Reightler has logged more than 128 hours in space and 4,500 hours flying time in over 60 different types of aircraft.

Dr. N. Jan Davis, Ph.D., 40, is mission specialist 1 (MS1) on STS-60. Selected as an astronaut in 1987, Davis considers Huntsville, Al., her hometown and will be making her second space flight.

Davis graduated from Huntsville High School in 1971; received bachelors' degrees in applied biology from the Georgia Institute of Technology and in mechanical engineering from Auburn University in 1975 and 1977, respectively; and received a master's and a doctorate in mechanical engineering from the University of Alabama in Huntsville in 1983 and 1985, respectively.

Davis joined NASA's Marshall Space Flight Center in 1979 as an aerospace engineer, where, in 1986, she was named team leader in the Structural Analysis Division. Projects with which Davis was involved during her tenure at Marshall included structural analysis of the Hubble Space Telescope, the Advanced X-Ray Astrophysics Facility and the redesign of the Shuttle solid rocket booster external tank attach ring. After her selection as an astronaut, she first flew aboard Endeavour in September 1992 on Shuttle mission STS-47.

Davis has logged more than 188 hours in space.

Dr. Ronald M. Sega, Ph.D., 41, is mission specialist 2 (MS2) on STS-60. Selected as an astronaut in 1991, Sega considers Northfield, Ohio, and Colorado Springs, Co., his hometowns, and he will be making his first space flight.

Sega graduated from Nordonia High School, Macedonia, Ohio, in 1970; received a bachelor's degree in mathematics and physics from the Air Force Academy in 1974; received a master's in physics from Ohio State University 1975; and received a doctorate in electrical engineering from the University of Colorado in 1982.

Sega completed Air Force pilot training in 1974 and served as an instructor pilot in the Air Force from 1976-1979. From 1979-1982, he was on the faculty of the Air Force Academy's Dept. of Physics, and, from 1982 through 1990 was actively on the faculty of the University of Colorado in Colorado Springs, from which he is currently on a leave of absence. From 1989-1990, while on leave from the University of Colorado, Sega served as research associate professor of physics at the University of Houston and is a co-principal investigator of the Wake Shield Facility.

Sega has logged more than 3,700 hours flying time in aircraft.

Dr. Franklin R. Chang-Diaz, Ph.D., 43, is payload commander and mission specialist 3 (MS3) on STS-60. A native of San Jose, Costa Rica, Chang-Diaz was selected as an astronaut in 1980 and will be making his fourth space flight.

Chang-Diaz graduated from Colegio De La Salle in San Jose in 1967 and from Hartford High School, Hartford, Ct., in 1969. He received a bachelor's degree in mechanical engineering from the University of Connecticut in 1973; and received a doctorate in applied plasma physics from the Massachusetts Institute of Technology in 1977.

Chang-Diaz has been a visiting scientist with the MIT Plasma Fusion Center since 1983, working with the institute to develop a future propulsion system for spacecraft based on magnetically confined high temperature plasmas. As an astronaut, his non-flight assignments have included starting the Astronaut Science Colloquium Program and the Astronaut Science Support Group, implementing closer ties between the astronaut corps and the scientific community.

Chang-Diaz first flew on STS-61C in January 1986 as a mission specialist. His second flight was on STS-34 in October 1989, and his third Shuttle flight was on STS-46 in August 1992.

Chang-Diaz has logged more than 457 hours in space.

Sergei Konstantinovich Krikalev, 35, a Russian Space Agency cosmonaut, is mission specialist 4 (MS4) on STS-60. A native of St. Petersburg, Russia, Krikalev is one of two candidates named by the Russian Space Agency to fly on the Space Shuttle. Krikalev is a veteran of two flights in space, both long-duration stays aboard the Russian Mir Space Station.

Krikalev graduated from high school in 1975 and received a mechanical engineering degree from the Leningrad Mechanical Institute, now renamed the St. Petersburg Technical University, in 1981.

Krikalev joined NPO Energia, the Russian industrial organization responsible for manned space flight activities in 1981, and his duties included testing space flight equipment, developing space operations methods, and ground control operations. He worked with the rescue team for the Salyut 7 space station failure in 1985, developing methods for docking with the uncontrolled station and for repair of the station.

Krikalev was selected as a cosmonaut in 1985 and first flew aboard Soyuz TM-7 as a flight engineer. The Soyuz TM-7 mission was launched Nov. 26, 1988, and the crew stayed aboard the Mir space station until their return on April 27, 1989.

His next flight was as flight engineer aboard Soyuz TM-12, the ninth Mir mission, launched on May 19, 1991. Krikalev remained aboard the Mir station, performing seven spacewalks during his stay, until his return on March 25, 1992.

Krikalev has logged a total of more than 1 year and three months in space.

SHUTTLE FLIGHTS AS OF DECEMBER 1993

59 TOTAL FLIGHTS OF THE SHUTTLE SYSTEM -- 34 SINCE RETURN TO FLIGHT

STS 51-L 01/28/86	STS-58 10/18/93 - 11/01/93	STS-51 09/12/93 - 09/22/93		
STS 51-A 10/30/85 - 11/06/85	STS-55 04/26/93 - 05/06/93	STS-56 04/08/93 - 04/17/93		
STS 51-F 07/29/85 - 08/06/85	STS-52 10/22/92 - 11/1/92	STS-53 12/2/92 - 12/9/92		
STS 51-B 04/29/85 - 05/6/85	STS-50 06/25/92 - 07/09/92	STS-42 01/22/92 - 01/30/92		
STS 41-G 10/5/84 - 10/13/84	STS-40 06/05/91 - 06/14/91	STS-48 09/12/91 - 09/18/91		
STS 41-C 04/06/84 - 04/13/84	STS-35 12/02/90 - 12/10/90	STS-39 04/28/91 - 05/06/91	STS-46 7/31/92 - 8/8/92	
STS 41-B 02/03/84 - 02/11/84	STS-32 01/09/90 - 01/20/90	STS-41 10/06/90 - 10/10/90	STS-45 03/24/92 - 04/02/92	
STS-8 08/30/83 - 09/05/83	STS-28 08/08/89 - 08/13/89	STS-31 04/24/90 - 04/29/90	STS-44 11/24/91 - 12/01/91	
STS-7 06/18/83 - 06/24/83	STS 61-C 01/12/86 - 01/18/86	STS-33 11/22/89 - 11/27/89	STS-43 08/02/91 - 08/11/91	
STS-6 04/04/83 - 04/09/83	STS-9 11/28/83 - 12/08/83	STS-29 03/13/89 - 03/18/89	STS-37 04/05/91 - 04/11/91	
	STS-5 11/11/82 - 11/16/82	STS-26 09/29/88 - 10/03/88	STS-38 11/15/90 - 11/20/90	
	STS-4 06/27/82 - 07/04/82	STS 51-I 08/27/85 - 09/03/85	STS-36 02/28/90 - 03/04/90	
	STS-3 03/22/82 - 03/30/82	51-G 06/17/85 - 06/24/85	STS-34 10/18/89 - 10/23/89	STS-61 12/2/93 - 12/13/93
	STS-2 11/12/81 - 11/14/81	51-D 04/12/85 - 04/19/85	STS-30 05/04/89 - 05/08/89	STS-57 6/21/93 - 7/1/93
	STS-1 04/12/81 - 04/14/81	STS 51-C 01/24/85 - 01/27/85	STS-27 12/02/88 - 12/06/88	STS-54 01/13/93 - 01/19/93
		STS 51-A 11/08/84 - 11/16/84	STS 61-B 11/26/85 - 12/03/85	STS-47 09/12/92 - 09/20/92
		STS 41-D 08/30/84 - 09/04/84	STS 51-J 10/03/85 - 10/07/85	STS-49 05/07/92 - 05/16/92
OV-099 Challenger (10 flights)	OV-102 Columbia (15 flights)	OV-103 Discovery (17 flights)	OV-104 Atlantis (12 flights)	OV-105 Endeavour (5 flights)

Donald Savage
Headquarters, Washington, D.C.
(Phone: 202/358-1547)

For Release
January 26, 1994

Keith Koehler
Wallops Flight Facility, Wallops Island, Va.
(Phone: 804/824-1579)

RELEASE: 94-12

NASA STUDYING AURORAS OVER ALASKA USING SUBORBITAL ROCKETS

NASA and an international group of scientists will conduct an extensive study of auroras over Alaska using suborbital rockets and ground instruments during late January through March 1994, NASA officials announced today.

During this period, NASA will launch eight sounding rockets from the Poker Flat Research Range near Fairbanks, Alaska, to study the composition of auroras and their effects on the surrounding atmosphere. The launch window for the first launch opens beginning Thursday, Jan. 27.

Auroras, or "Northern Lights," are a result of the interaction of charged particles from the sun with the Earth's magnetic field in the upper atmosphere. These energized particles excite the gases present in the upper atmosphere, causing them to emit light that is called the aurora.

However, the acceleration process that energizes these particles is not thoroughly understood, according to Dr. Roy Torbert from the University of New Hampshire and principal investigator of one of the missions.

These sounding rocket missions will allow scientists to take in-situ measurements (fly their experiments through the auroras) to gain a better understanding of this phenomena.

Also, studying the auroras will help scientists understand the relationship of this interaction of the sun's energy with the Earth's upper atmosphere, according to Torbert.

Torbert's flight uses one of the most sophisticated payloads to fly on a NASA sounding rocket. The 21-foot (6.4 meter) long payload, called the Auroral Turbulence Rocket, includes 28 instruments and consists of a main payload and two subpayloads.

- more -

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The two subpayloads will be deployed from the main payload in space. Simultaneous measurements from the three spacecraft will allow Torbert and his team to study the variations, in space and time, of the plasma physical properties occurring within and around an aurora. Data will be gathered over 9 minutes of the approximately 12- minute flight.

The eight missions will be conducted using two-, three- and four-stage solid-fueled rockets. The unguided rockets, which range in length from 36 feet (11 meters) to 73 feet (22 meters), will carry their payloads to altitudes from 55 miles (88 kilometers) to 287 miles (462 kilometers).

The Alaska missions are just eight of nearly 50 missions scheduled worldwide through September 1994 by the NASA Sounding Rocket Program. The projects are managed by the NASA Goddard Space Flight Center's Wallops Flight Facility, Wallops Island, Va., for the Office of Space Science, NASA Headquarters, Washington, D.C.

- end -

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 453-8400



Terri Sindelar
Headquarters, Washington, D.C.
(Phone: 202/358-1977)

For Release

January 28, 1994
4 p.m. EST

RELEASE: 94-13

NASA FOSTERS AEROSPACE RESEARCH IN STATES

NASA today announced a new initiative that will strengthen the research capability of six states and increase their competitiveness in space and aeronautics research activities.

The NASA Experimental Program to Stimulate Competitive Research (EPSCoR) Program will provide funding to enable the states to develop an academic research enterprise directed toward long-term, self-sustaining, nationally competitive capability in space science and applications and aeronautical and space research and technology programs. This capability will contribute to the state's economic viability.

The six states selected for the 3-year, \$500,000 annual award include Alabama, Arkansas, Kentucky, Louisiana, Montana and the Commonwealth of Puerto Rico.

"After a thorough peer review process, we determined that these six state proposals clearly showed the most potential to contribute to NASA's mission and to build the states' long term capability," said Spence Armstrong, Associate Administrator for NASA's Office of Human Resources and Education. Armstrong also indicated that NASA will work through existing programs, such as the Space Grant Capability Enhancement Program, to build upon the excellent components found in the other proposals.

The states eligible to apply for this award were designated by the National Science Foundation (NSF) as eligible for the NSF EPSCoR and/or those states currently designated as Capability Enhancement grantees in NASA's National Space Grant College and Fellowship Program.

- more -

NSF established EPSCoR in 1979 in response to congressional concerns that federal R&D efforts supported only a handful of states. A decade later, in 1990, Congress began the process of expanding EPSCoR beyond NSF. Consequently, NASA along with the Departments of Agriculture, Energy and Defense, the Environmental Protection Agency and the National Institutes of Health are developing or implementing EPSCoR programs.

The NASA EPSCoR program was conceived to improve a states competitive research capacity in areas relevant to the agency's mission. NASA EPSCoR should contribute to a stronger science and technology base, broaden geographic participation of technologically sophisticated businesses and industries while supporting a more competitive national economy, strengthen science education and expand science and engineering training opportunities particularly for women and minorities and reinforce the importance of supporting science and technology.

The selected states will use the award for research funding and to enhance the existing infrastructure by purchasing equipment, supporting graduate students and funding interdisciplinary research activities. Developing the infrastructure will require enhanced interaction and cooperation in research and in technology information dissemination among universities, state government and business and industry in the state.

- end -

Editor's Note: A list of participating institutions in the selected states can be obtained by contacting the NASA Headquarters Newsroom on 202/358-1600.

NASA/EPSCoR Program Awards
College/University Participation in NASA/EPSCoR Program

January 1994

Alabama

Alabama A&M University, Normal
Alabama School of Math and Science, Mobile
Athens State College, Athens
Auburn University, Auburn
Birmingham Southern College, Birmingham
Jacksonville State University, Jacksonville
Miles College, Birmingham
Oakwood College, Huntsville
Samford University, Birmingham
Spring Hill College, Mobile
Stillman College, Tuscaloosa
University of Alabama, Tuscaloosa
University of Alabama at Birmingham
University of Alabama in Huntsville
University of South Alabama, Mobile

Arkansas

Arkansas College, Batesville
Arkansas State University, State University
University of Arkansas, Fayetteville
University of Arkansas at Little Rock
University of Arkansas for Medical Sciences, Little Rock
University of Arkansas at Monticello
University of Arkansas at Pine Bluff
University of Central Arkansas, Conway

Kentucky

Eastern Kentucky University, Richmond
University of Kentucky, Lexington
University of Louisville
Western Kentucky University, Bowling Green

Louisiana

Dillard University, New Orleans
Louisiana State University and A&M College, Baton Rouge
Louisiana State University Agricultural Center, Baton Rouge
Louisiana Tech University, Ruston
Louisiana Universities Marine Consortium, Chauvin
McNeese State University, Lake Charles
Southern University and A&M College, Baton Rouge
Tulane University, New Orleans
University of New Orleans
Xavier University of Louisiana, New Orleans

Montana

Eastern Montana College, Billings
Montana College of Mineral Science and Technology, Butte
Montana State University, Bozeman
Northern Montana College, Havre
University of Montana, Missoula
Western Montana College of the University of Montana, Dillon

Puerto Rico

Arecibo Observatory
International Institute of Tropical Forestry, Rio Piedras
Terrestrial Ecology Division, Central Administration,
University of Puerto Rico, San Juan
University of Puerto Rico, Mayaguez Campus
University of Puerto Rico, Rio Piedras Campus

Drucella Andersen
Headquarters, Washington, D.C.
(Phone: 202/358-4701)

For Release
January 31, 1994

Michael Mewhinney
Ames Research Center, Mountain View, Calif.
(Phone: 415/604-9000)

RELEASE: 94-14

NASA TESTS NOISE-REDUCING NOZZLE FOR SUPERSONIC AIRLINERS

NASA is evaluating an advanced exhaust nozzle concept that could reduce noise made by 21st century supersonic jet airliners to the level of today's new subsonic jets without affecting takeoff performance.

The wind tunnel tests at NASA's Ames Research Center, Mountain View, Calif., uses an experimental nozzle attached to the rear of a one-tenth scale model of a jet engine. The subscale engine simulates the exhaust of a future supersonic airliner under takeoff conditions. Jet engine noise comes from a plane's exhaust or "plume" of turbulent air in its wake.

"This future supersonic airliner undoubtedly will have to comply with Federal Aviation Administration regulations, so we're trying to make it as quiet as future subsonic airliners," said Ames Project Manager Paul Soderman.

The nozzle is an "ejector suppressor" type designed by GE Aircraft Engines, Cincinnati. It scoops in outside air and mixes it with the high-energy jet exhaust. That lowers the speed of the exhaust and consequently, the noise.

In the tests, engineers use a laser and an infrared video system to measure the engine's exhaust flow. They also employ a pair of microphones mounted on 15-foot struts to measure the noise. The struts move back and forth beside the nozzle to obtain data.

"We know how much noise a jet engine makes in our wind tunnel," said Soderman, an aeronautical and acoustical engineer. "We want to learn how much noise it makes with an advanced suppressor on."

-more-

"We're also testing the engine's thrust loss caused by using the ejector suppressor, because thrust loss affects a plane's takeoff performance," Soderman added. "If we can keep the loss below 5 percent, we will be very pleased."

The nozzle tests in the 40- by 80-foot test section of Ames' National Full-Scale Aerodynamics Complex are the first in a scheduled series. They are all part of NASA's High-Speed Research Program, which is conducting research to provide technology for an environmentally compatible, economically practical next-generation supersonic transport.

-end-

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202 453-8400



For Release

Beth Schmid
Headquarters, Washington, D.C.
(Phone: 202/358-1760)

February 1, 1994

N94-12

NOTE TO EDITORS: NASA FY 1995 BUDGET BRIEFING SCHEDULED

A briefing on NASA's fiscal year 1995 budget request will be held Monday, Feb. 7, at 1:00 p.m. EST in the NASA Headquarters Auditorium, 300 E St., S.W., Washington, D.C.

Participants will include NASA Administrator Daniel S. Goldin and NASA Chief Financial Officer Malcolm Peterson. A summary of the budget request will be distributed at the beginning of the press conference.

The briefing will be carried live on NASA Select television (Spacenet 2, transponder 5, (channel 9) horizontal polarization, frequency 3880.0 MHz, audio 6.8 MHz, 69 degrees west longitude.)

-end-

NASA News

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ISI

Mark Hess
Headquarters, Washington, D.C.
(Phone: 202/358-1400)

For Release

February 2, 1994

Kari Fluegel
Johnson Space Center, Houston
(Phone: 713/483-5111)

Kari Thornton
Boeing Defense and Space Systems Group, Seattle
(Phone: 713/280-2028)

RELEASE: 94-15

NASA MARKS SPACE STATION MILESTONE

NASA passed a major milestone in the Space Station Program Tuesday when agency and contractor officials signed documents that mark the end of the Freedom Work Package contracts, thus concentrating responsibility for the design, development and integration of the program under a single prime contract with Boeing Defense and Space Systems Group, Seattle.

"This event is just one indicator that work on the International Space Station is on track and moving ahead," said Randy Brinkley, Manager of the NASA Space Station Program Office, Houston. "A large group of people has been working very hard over the last several months to make the transition from the Freedom program to our current redesigned program. Because of their efforts, we are well on our way to having an international laboratory in space."

One of the documents signed yesterday was a major modification to the Nov. 15, 1993, letter contract between NASA and Boeing. This modification changes Boeing's scope of work from a transitional contract to a hardware design and development contract. A final contract between NASA and Boeing will be definitized later this year.

-more-

Boeing was designated as the prime contractor in August 1993 following a recommendation by the Station Redesign Team to strengthen Space Station integration by realigning the separate hardware development contracts under a single prime contractor. As the prime contractor, Boeing will be responsible for the design, development, physical and analytical integration, and test and delivery of the Space Station vehicle. After contract realignment, Boeing will be responsible for the management of two major subcontracts with McDonnell Douglas and Rocketdyne.

"This contact is a major milestone for Boeing," said Larry Winslow, Boeing Vice President for the Space Station Program. "We are excited to lead the team to design, build and launch a superb orbiting laboratory."

Four party agreements also were signed which will officially close off the three work package contracts with the Boeing Defense and Space Group (Work Package 1), McDonnell Douglas Corp. (Work Package 2) and the Rocketdyne Division of Rockwell International (Work Package 4). The four-party agreements, known as novation, mark the end of the work package structure that existed under the Freedom program.

The work formerly performed by the three work package contractors will continue with McDonnell Douglas and Rocketdyne now being subcontractors to Boeing. McDonnell Douglas and Rocketdyne will continue to be responsible for their specific hardware development efforts and for supporting Boeing in sustaining engineering activities.

Overall, the agreements signal the end of the transition from the Space Station Freedom program to the redesigned space station program.

The International Space Station will be a multi-functional orbiting laboratory used for scientific and technology research in the unique microgravity environment of space. The effort pulls together capabilities and resources from NASA; the European Space Agency; NASDA, the Japanese Space Agency; the Canadian Space Agency; and most recently, the Russian Space Agency.

On-orbit construction of the facility will begin in 1997 and will use the launch capabilities of both the United States and Russia. A U.S. Laboratory module will be operational after the fourth U.S. assembly flight. U.S. launches will continue to add Japanese and European laboratory modules, a Canadian-built robotic arm and a habitation module. Russia will fly a "space tug," a science module, a power platform and a number of research modules.

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Headquarters, Washington, D.C.
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For Release

February 3, 1994

Debra Rahn
Headquarters, Washington, D.C.
(Phone: 202/358-1639)

Kyle Herring
Johnson Space Center, Houston
(Phone: 713/483-5111)

RELEASE: 94-16

ASTRONAUTS THAGARD AND DUNBAR TO TRAIN FOR FLIGHT ON MIR

NASA today announced that astronauts Norman E. Thagard, M.D., and Bonnie J. Dunbar, Ph.D., have been selected as the prime and backup crew members for a 3-month flight on the Russian space station Mir in 1995. The two veteran astronauts will begin training in Star City, Russia in February.

Thagard will fly onboard Soyuz 18 with two Russian cosmonauts to Mir in March 1995. They will spend approximately 90 days aboard the space station. In June 1995, the crew of mission STS-71 aboard Space Shuttle Atlantis is scheduled to dock with Mir. The Shuttle crew will include two Russian cosmonauts, designated Soyuz 19, who will replace Thagard and the Soyuz 18 crew. That three person crew will return to Earth at the conclusion of Atlantis' mission.

Thagard and Dunbar's assignments are being made to respond to the rapidly expanding U.S./Russia human space flight cooperation. This cooperation consists of a three-phased program. Phase one consists of up to 10 Space Shuttle-Mir missions between 1995 and 1997, including rendezvous, docking and crew transfers. The Space Shuttle will assist with crew exchange, resupply and payload activities for Mir.

- more -

A Russian cosmonaut currently is flying aboard the STS-60 Space Shuttle mission launched today. Another cosmonaut will fly on STS-63 in January 1995. Four or more U.S. astronaut stays on the Mir station are planned, totaling more than 2 years of on-orbit time.

Phase two is the joint development of the core international space station program. Phase three is the expansion of the space station to include all of the international partners.

As backup, Dunbar will undergo the same training as Thagard to be ready to serve on the flight crew should that become necessary. The training also will allow her to be eligible to serve on a later MIR crew mission or on a later Shuttle flight that docks with the MIR station.

Thagard, 50, served as mission specialist on four Shuttle flights. He has a variety of experience in space, having deployed a number of spacecraft, including the Magellan planetary probe to Venus. He has performed numerous multi-disciplinary scientific experiments in the pressurized Spacelab module housed in the orbiter's payload bay.

Thagard received bachelor and master of science degrees in engineering science in 1965 and 1966 from Florida State University and received a doctor of medicine degree from the University of Texas Southwestern Medical School in 1977. He was born in Marianna, Fla., but considers Jacksonville his hometown. Thagard was selected as an astronaut in 1978.

Dunbar, 44, has flown three times on the Shuttle. Her first flight, STS 61-A, was the first Spacelab mission with experiment work controlled from outside the United States. Her second flight was as a mission specialist on STS-32 to deploy a satellite and retrieve the Long Duration Exposure Facility deployed from the Shuttle on an earlier flight. Her most recent flight was as Payload Commander on the 13-day U.S. Microgravity Laboratory mission.

For the last year, Dunbar has served as the Deputy Associate Administrator for Microgravity Research at NASA Headquarters.

Dunbar graduated from the University of Washington in 1971 and 1975, respectively, with bachelor and masters degrees in ceramic engineering. She received her doctorate in biomedical engineering from the University of Houston in 1983. Dunbar was born in Sunnyside, Washington. She was selected to be an astronaut in 1980.

As the U.S./Russia cooperative activities progress, it is anticipated that additional NASA personnel will be assigned to support agency activities in Russia.

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For Release

February 3, 1994

RELEASE: 94-17

NASA/INDUSTRY PIONEER TECHNOLOGY REINVESTMENT PROGRAM

NASA and Hi-Shear Technology Corp., Torrance, Calif., have teamed together in a cooperative agreement as part of the Technology Reinvestment Program (TRP) to develop a new generation of portable emergency rescue equipment. This is the first such government/industry TRP partnership.

The equipment will use NASA-developed pyrotechnical technology to modernize current hydraulic-powered cutters used by fire and rescue teams to free accident victims from wreckages. The \$1.6 million program will be developed with the assistance of the Torrance, Calif., fire department.

Current emergency rescue equipment uses expensive, gasoline-powered hydraulic pumps, hoses and cutters to perform these rescue services. Using NASA technology and Hi-Shear Technology research, the new generation cutters will eliminate umbilical connections to cumbersome hydraulic pumps by using pyrotechnic cartridges, which will create an estimated 50 percent weight savings and a 70 percent cost reduction in the equipment.

This new generation of equipment will be cost-effective for smaller fire departments and rescue squads as well as portable enough for military and civil search and rescue helicopter operations.

The joint effort by NASA and Hi-Shear Technology represents an example of NASA's desire to transfer government-sponsored technology applications over to America's commercial markets. This activity will preserve an important aerospace industry by transitioning this government-developed technology into commercial products and should generate millions of dollars in cost savings for local, state and federal government rescue services.

The Department of Defence Advanced Research Projects Agency is the TRP lead agency. NASA, the Departments of Commerce, Energy and Transportation and the National Science Foundation are participating members in the joint Technology Reinvestment Program.

- end -

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For Release

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(Phone: 202/358-1760)

February 4, 1994

NOTE TO EDITORS: N94-13

NASA FY 1995 BUDGET BRIEFING RESCHEDULED

The NASA FY 1995 budget briefing has been rescheduled to 2 p.m. EST on Monday, February 7, due to a conflict with the Office of Science and Technology Policy (OSTP) briefing scheduled at 1 p.m. The NASA briefing will be in the agency auditorium, 300 E St., S.W., Washington, D.C.

The briefing will be carried live on NASA Select television (Spacenet 2, transponder 5, (channel 9) horizontal polarization, frequency 3880.0 MHz, audio 6.8 MHz, location 69 degrees west longitude.)

NASA News

National Aeronautics and
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For Release

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February 4, 1994

RELEASE: 94-18

NASA SELECTS SMALL BUSINESS INNOVATION RESEARCH PROJECTS

NASA announced today the selection of 42 additional proposals for negotiation of Phase II contract awards in NASA's Small Business Innovation Research Program (SBIR). These selections are in addition to the 130 announced in December 1993, making a total of 172 Phase II selections in the current program.

The additional 42 Phase II projects are expected to have a total contract value of approximately \$21 million. They will be conducted by 38 small, high-technology firms located in 16 states.

SBIR goals are to stimulate technological innovation, increase the use of small business (including minority and disadvantaged firms) in meeting federal research and development needs and increase private sector commercialization of results of federally funded research.

Phase I project objectives are to determine feasibility of research innovations proposed by small firms to meet agency needs. Phase II continues development of the most promising Phase I projects. Selection criteria include technical merit and innovation, Phase I results, expected value to NASA and commercial potential, and company capabilities to perform their proposed research projects. Funding for Phase II contracts may be up to \$600,000 for a 2-year performance period.

All selections were made from a group of 327 Phase II proposals submitted by SBIR contractors completing Phase I projects initiated in 1992. The expected total value of all 172 Phase II contracts is approximately \$86 million.

The SBIR program is managed by NASA's Office of Advanced Concepts and Technology, NASA Headquarters, Washington, D.C. A listing of companies and projects selected for this program is available at NASA Headquarters (Phone: 202/358-1600) and all NASA field centers.

- end -

NASA News

National Aeronautics and
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AC 202 358-1600



Brian Dunbar
Headquarters, Washington, D.C.
(Phone: 202/358-1547)

For Release
February 4, 1994

Jim Doyle
Jet Propulsion Laboratory, Pasadena, Calif.
(Phone: 818/354-5011)

RELEASE: 94-19

NASA TRACKS LAND-SURFACE MOVEMENT IN JAN. 17 EARTHQUAKE

Oat Mountain in the Santa Susana range, just north of the San Fernando Valley, jumped several inches during the 6.6 earthquake that struck Los Angeles on Jan. 17, said a scientist at NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif.

Other locations, including some communities, also were jerked into new positions, said Dr. Andrea Donnellan, a JPL geophysicist.

The 3,618-foot-high (1,103 meters) mountain, jumped up 14.8 inches (38 centimeters). It also moved north 6.2 inches (16 centimeters) and west 5.5 inches (14 centimeters).

JPL has continuously operated stations at Oat Mountain and at Cal State University, Northridge, since the earthquake. The data suggest that Oat Mountain has risen about one more inch (2 to 3 centimeters) since the quake. The site also moved slightly more than an inch (3 centimeters) back to the south after the 5.0 aftershock Jan. 29.

"This is mountain building in progress," said Donnellan. Donnellan and her colleagues measured the movements of the mountain and several other Southern California locations following the devastating earthquake using Global Positioning System (GPS) instruments -- ground receivers that track orbiting navigation satellites.

The Defense Department's GPS network includes 24 Earth-orbiting satellites at 12,400 miles (20,000 kilometers) that send microwave transmissions to ground receivers worldwide.

- more -

NASA collects data from a global network of 45 stations. The data tells scientists how far the Earth's surface has moved in any given period of time. In addition, portable instruments are deployed at other locations around the world.

Donnellan said the 6.6 quake occurred on a fault at the southern and eastern edge of the Ventura Basin, a 62-mile (100-kilometer) by 6-mile (10 kilometer) sub-surface feature that stretches from the Pacific Ocean to the San Fernando Valley. At 9.3 miles (15 kilometers) deep, the basin is one of the deepest sedimentary basins on Earth, she said.

Donnellan had been studying the basin since 1987 and came to the conclusion its deep faults were capable of causing a serious earthquake. In a paper she published in the science journal Nature last November, she predicted the basin could suffer an approximately 6.4-magnitude earthquake.

Her studies, using the GPS instruments, indicated the basin was being squeezed from north and south about 0.3 inches (7 millimeters) a year by the movement of the Santa Susana and Santa Ynez ranges.

"It's a north-south closure of the valley," she said. The figures came from analysis of data recorded in the GPS receivers at several locations around the basin.

She said she and her colleagues used computer modeling to look at the faults beneath the basin from a considerable depth up to the surface and saw they were locked, that is, not slipping to relieve strain. From that model they calculated the potential magnitude of a quake that could strike the region. Although the scientists predicted the locale and size of the earthquake, they could not predict when such a quake might occur.

The Oat Mountain receiver was the location closest to the quake's epicenter and over the highest density of aftershocks. The epicenter was in the valley community of Reseda. The fault, however, is not a single point, but affects a large section of surface ground. The hardest hit area was the community of Northridge, immediately adjacent to Reseda. Most of Northridge overlies the ruptured fault plane.

Several other communities along the basin also were jerked into new positions. GPS data indicated that the community of Fillmore in Ventura County, which lost much of its downtown section, moved west 2 inches (5 centimeters). The region near Castaic moved southwest 4.3 inches (11 centimeters) and down 3.5 inches (9 centimeters). Santa Paula and Moorpark also were moved westward 1 to 2 inches (approximately 2.5 to 5 centimeters) and the Point Dune area moved due north 1.5 inches (4 centimeters).

In addition to analyzing scientific data from the earthquake, NASA's Airborne Science and Applications program has been conducting surveys of the damage in the area. Data from instruments aboard NASA's C-130 and ER-2 aircraft has been provided to the Federal Emergency Management Administration and local governments to help them assess the damage.

Both JPL's GPS studies and the aircraft surveys, managed by NASA's Ames Research Center, Mountain View, Calif., are funded by NASA's Office of Mission to Planet Earth, Washington, D.C. Mission to Planet Earth (MTPE) is studying how Earth's global environment is changing. Using the unique perspective available from space, NASA is observing, monitoring and assessing large-scale environmental processes, focussing on climate change.

MTPE satellite data, complemented by aircraft and ground data, is allowing scientists to better understand environmental changes and to distinguish human-induced changes from natural changes. MTPE data, which NASA is distributing to researchers worldwide, is essential to humans making informed decisions about protecting their environment.

NASA News

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Sarah Keegan
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For Release

February 7, 1994

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Ray Villard
Space Telescope Institute, Baltimore, Md.
(Phone: 410/338-4514)

EDITORS NOTE: N94-14

HST IMAGES AVAILABLE OF COMET ON COLLISION COURSE WITH JUPITER

A color image of Comet P/Shoemaker-Levy 9 (1993e) is being made available to the media from NASA and its Hubble Space Telescope Science Institute, Baltimore, Md. The three-frame, 8 x 10 image shows the comet broken into about 20 pieces as the result of the gravitational pull of Jupiter when the comet passed by the massive planet in summer 1992.

The cometary fragments are on a collision course with Jupiter and are expected to plunge into the Jovian atmosphere during a 5-1/2-day period centered on July 19, 1994, possibly with spectacular results.

The images are from July 1993, which is prior to servicing of Hubble, and from January 1994, a month after the space telescope was equipped with improved optics by astronauts on an 11-day mission aboard the Space Shuttle Endeavour.

Images are available from three locations: The Hubble Space Telescope Science Institute, Baltimore, Md. (410/338-4707); NASA's Goddard Space Flight Center, Greenbelt, Md. (301/286-5565); and NASA Headquarters, Washington, D.C. (202/358-1900). For color, request photo 94-HC-39 -- for black and white, 94-H-42 at NASA Headquarters. Images are EMBARGOED until 11 a.m. EST Today.

- end -



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For Release
February 7, 1994

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RELEASE: 94-20

NASA BEGINS DEVELOPMENT OF NEW MARS EXPLORATION PROGRAM

NASA will continue to explore Mars with a new exploration strategy in fiscal year 1995. The Mars Surveyor program calls for start of development of a small orbiter that will be launched in November 1996 to study the surface of the red planet.

The Mars Surveyor orbiter will lay the foundation for a series of missions to Mars in a decade-long program of Mars exploration. The missions will take advantage of launch opportunities about every 2 years as Mars comes into alignment with Earth.

NASA requested \$77 million in development costs in FY 1995 for the new Mars orbiter. The announcement was made during NASA's press briefing on the 1995 budget request. The 1995 fiscal year runs from Oct. 1, 1994, to Sept. 30, 1995.

The Mars Surveyor program will be conducted within the constraints of a cost ceiling of approximately \$100 million per year. The orbiter will be small enough to be launched on a Delta expendable launch vehicle and will carry roughly half of the science payload that flew on Mars Observer, which was lost on Aug. 21, 1993. The specific instruments will be selected later.

NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif., will issue a request for proposals to industry in mid-March to solicit potential spacecraft designs. Selection of a contractor to build the spacecraft will be made by July 1.

NASA envisions an orbiter/lander pair of spacecraft as the next in this series of robotic missions to Mars.

- more -

- 2 -

The orbiter planned for launch in 1998 would be even smaller than the initial Mars Surveyor orbiter and carry the remainder of the Mars Observer science instruments. It would act as a communications relay satellite for a companion lander, launched the same year, and other landers in the future, such as the Russian Mars '96 lander. The U.S. Pathfinder lander, set to land on Mars in 1997, will operate independently of the Mars orbiter.

The 1998 orbiter/lander spacecraft would be small enough to be launched on an expendable launch vehicle about half the size and cost of the Delta launch vehicle.

JPL will manage mission design and spacecraft operations of the Mars Surveyor for NASA's Office of Space Science, Washington, D.C.

- end -

Donald Savage
Headquarters, Washington, D.C.
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For Release
February 9, 1994

Mary Ann Peto
Lewis Research Center, Cleveland
(Phone: 216/433-2902)

RELEASE: C94-g

NASA SELECTS GENERAL DYNAMICS FOR CONTRACT NEGOTIATIONS

NASA's Lewis Research Center, Cleveland, has selected General Dynamics Commercial Launch Services, Inc., of San Diego, Calif., for negotiations leading to the award of a contract for two firm launches and options for seven additional launches using the Atlas intermediate expendable launch vehicle (IELV).

The amount of the contract under negotiation for the first firm launch ranges from \$100-150 million. The first mission to be launched will be the Earth Observing System-AM-1 spacecraft scheduled for 1998. The second firm mission, as well as the seven options, only will be assigned and procured if necessary to support future missions requiring an IELV. A potential candidate for the second launch is the Geostationary Operational Environmental Satellite-L mission.

The fixed-price launch services contract with economic price adjustment is for 10 years, with an anticipated start date of September 1994, if all options are exercised.

The contractor is responsible for delivery of spacecraft on-orbit which encompasses assembly, checkout and launch. The contractor also will provide post-flight data analysis and reporting.

Work will be performed at General Dynamics, Commercial Launch Services, San Diego, Calif., and Harlingen, Texas; Thiokol Corp., Huntsville, Ala.; Gulton Industries, Inc., Albuquerque, N.M.; Honeywell Space Systems Group, Clearwater, Fla.; United Technologies, Pratt and Whitney, Palm Beach, Fla.; and Rockwell International, Rocketdyne Division, Canoga Park, Calif.

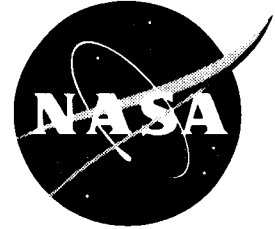
It is anticipated that 8 percent of the total contract dollars is to be awarded to small, disadvantaged businesses.

- end -

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For Release

Drucella Andersen
Headquarters, Washington, D.C.
(Phone: 202/358-4701)

February 9, 1993

Michael Mewhinney
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RELEASE: 94-21

NASA-ARMY RESEARCH PAVES WAY FOR BETTER HELICOPTERS

Future helicopters will be quieter and more efficient thanks to data from hundreds of hours of test flights during a 10-year NASA-Army research program.

Launched in 1984, the UH-60 Airloads Program at NASA's Ames Research Center, Mountain View, Calif., studied helicopter rotor vibration, noise, motion and airflows. The \$6 million project, which will conclude this month, gives engineers information they need to develop new helicopters and improve existing designs more quickly and cheaply.

"We've gathered a huge data base for the helicopter industry and the academic world to help refine the ability to design helicopters and predict their performance," said Ames Project Manager Paul Loschke. "If you stored all our data on those little floppy computer disks, the stack of disks would be 570 feet high; that's taller than the Washington Monument."

"Industry is always pleased to have the support of NASA research -- it's the wave of the future," said Rhett Flater, Executive Director of the American Helicopter Society, Alexandria, Va. "The transfer of data will be extremely useful to the rotorcraft community."

Bill Bousman, the project's principal investigator, noted that radical designs come along infrequently. When a new concept does look attractive, engineers need analytical tools to reduce rotor noise and vibration -- factors that affect passenger comfort and maintenance.

- more -

The real excitement in designing helicopters is how to make them quieter, better and cheaper to build and operate," Bousman said. "The big payoff is in reducing risk and cost."

The NASA-Army research used an Army UH-60 Black Hawk built by Sikorsky Aircraft Co., a division of United Technologies Corp., Stratford, Conn. The \$5 million helicopter can carry 10 passengers. The Army used the UH-60 to transport troops during Operation Desert Storm and in Somalia.

"The Black Hawk is very representative of a modern helicopter, and it was easy and less costly to get parts from the Army," Loschke said.

Sikorsky engineers built two specially designed instrumented rotor blades for the UH-60 Airloads Program. One blade had 242 pressure sensors to measure airloads along the blade. The second blade had instruments to measure the structural response to airloads and other aerodynamic conditions affecting the rotors.

"Airloads" are the forces on the rotor blades imparted by lift -- the upward force produced as the blades turn. Ames engineers studied how those forces and pressures affect a helicopter's performance, efficiency and noise.

"For example, when the blade is spinning around, it is generating lift and producing various noises like the popping sound you hear when a helicopter hovers," said Loschke. "The data from the program will help us better understand that phenomenon."

To record the flight test data, Ames developed special data acquisition systems mounted atop the rotor hub and in the cabin. Later, the data was put onto 5-inch optical laser disks in a "jukebox" computer storage system. Engineers and helicopter designers will be able to access the stored data by telephone with a computer modem.

- end -

NOTE TO EDITORS: A video clip of the UH-60 research is available to media by calling 202/358-1734. Still photos also are available, 202/358-1900

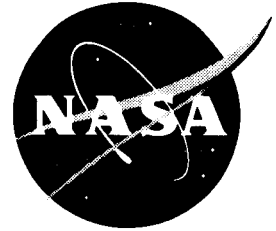
Color:
94-HC-33, -34

B&W:
94-H-36, -37

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For Release

Dwayne C. Brown
Headquarters, Washington, D.C.
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February 10, 1994

RELEASE: 94-22

NASA ANNOUNCES SOFTWARE OF THE YEAR AWARD

NASA's Office of Safety and Mission Assurance (OSMA), Washington, D.C., in conjunction with NASA's Inventions and Contributions Board (ICB), has created the Software of the Year Award to give recognition to software or software technology used by NASA.

"Software and software technology are essential to the success of NASA missions. This award is equal in stature to the Inventor of the Year Award," said Fred Gregory, Associate Administrator for OSMA.

The award, which will include a plaque and a monetary award of up to \$100,000 will be presented to author(s) of software programs or technologies promoted, adopted, sponsored and deemed significant in the performance of NASA space and aeronautics activities.

Entries will be judged by a NASA Software Award Review Panel comprised of software development experts. After their review, the panel will submit their selection(s) to the ICB. The panel may recommend a single monetary award of up to \$100,000 for a major contribution, several lesser awards, or no award when, in their opinion, no major or significant contribution can be clearly identified. The award will be presented by OSMA and ICB officials in late November at the NASA/Goddard Space Flight Center, Greenbelt, Md., annual Software Engineering Workshop.

"Copies of the software, sample applications and data and a description of the technology must be included, in addition to documentation demonstrating the impact and degree of innovation and suitability of the entry. This information will be the primary data used by the panel in recommending awards," said Don Sova, Manager for Software Engineering, NASA Headquarters.

- more -

Software programs are those packaged products submitted to the Computer Software Management and Information Center (COSMIC) at the University of Georgia. If submission is a software program, the software must be in the COSMIC inventory, in the process of submission to COSMIC, or legally disseminated via patent or copyright through a contractor with royalties to NASA.

Software technologies are non-patentable concepts, processes or development aids that may be utilized in the production or maintenance of high quality software products. If the submission is a software technology, adequate documentation must be provided to, or be in the process of submission to the National Technical Information Service (NTIS), Springfield, Va., to ensure availability.

Additional information on award criteria should be made through the NASA Awards Liaison Officer at any NASA Center or through the ICB. Entries and supporting material must be submitted to the NASA offices no later than June 1, 1994.

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For Release

Barbara Selby
Headquarters, Washington, D.C.
(Phone: 202/358-1983)

February 9, 1994

RELEASE: 94-23

WHITEHEAD NAMED NASA DEPUTY AA FOR AERONAUTICS

Dr. Robert E. Whitehead has been named Deputy Associate Administrator for NASA's Office of Aeronautics, NASA Headquarters, Washington, D.C.

"Bob Whitehead has made outstanding contributions to the development of NASA's subsonic programs," said Dr. Wesley L. Harris, Associate Administrator for Aeronautics, "and we are fortunate to have him in this position as we pursue our goals of improving U.S. competitiveness in civil aviation."

Prior to this appointment, Whitehead had been Director for Subsonic Transportation since January 1992. He joined NASA in 1989 as Assistant Director, Aeronautics (Rotorcraft) and, in January 1990, became Acting Assistant for Aeronautics (General Aviation and Transport Aircraft).

Whitehead began his career in 1970 as a post-doctoral research associate at NASA's Ames Research Center, Mountain View, Calif. From 1971-1976, he was a research engineer at the Department of the Navy's David Taylor Research Center.

In 1976, he joined the Office of Naval Research as scientific officer for aeronautics and later held positions as program manager for fluid dynamics (1981-1985) and Director, Mechanics Division (1985-1989).

Whitehead received B.S. (1967), M.S. (1969) and Ph.D. (1971) degrees in engineering mechanics, all from the Virginia Polytechnic Institute and State University. He is a member of the American Institute of Aeronautics and Astronautics and the American Helicopter Society.

- end -

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For Release

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Headquarters, Washington, D.C.
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February 10, 1994

Linda S. Ellis
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RELEASE: 94-24

HIGH-SPEED AIRCRAFT RESEARCH COMBUSTOR TESTS EXCEED GOAL

NASA-industry research experiments to reduce exhaust emissions to environmentally compatible levels for future supersonic airliners have yielded results that substantially exceed program goals.

The tests, which used an engine fuel combustion chamber sector, representing about one-fifth of a full-scale design, beat NASA's goal of generating no more than 5 grams of oxides of nitrogen (NOx) per kilogram of fuel burned at supersonic flight speed.

Scientific studies suggest that a fleet of future supersonic airliners, equipped with these ultra-low NOx engine combustors, possibly would have relatively small effects on stratospheric ozone.

"Protecting Earth's stratospheric ozone layer is our highest priority," said Louis J. Williams, Director of the High-Speed Research Program at NASA Headquarters, Washington, D.C., "so developing the technology to assure environmental compatibility for future supersonic airliners is the most important goal of our program."

"The results of these initial ultra-low emissions combustor tests make us more confident that we'll achieve that goal," Williams added.

The combustor sector evaluated was a "Lean Premixed Prevaporized" concept designed by GE Aircraft Engines, Evendale, Ohio. It mixes fuel and air upstream of the burning zone and allows enough time for the liquid fuel to vaporize completely before combustion.

-more-

The fuel-air mixture then enters the combustion system and ignites downstream of a flame stabilizer where the speed of the mixture flow is somewhat slower.

"The ultra-low levels of nitrogen oxide we've achieved in these tests are extremely encouraging. It shows that the ultra-low levels we previously saw in the laboratory can transition to combustor hardware," said Richard W. Niedzwiecki, Chief of the Combustion Technology Branch, Propulsion Systems Division at NASA's Lewis Research Center, Cleveland.

NASA also is testing a "Rich Burn-Quick Quench-Lean Burn" concept developed by Pratt & Whitney Division of United Technologies, East Hartford, Conn. This design uses two combustion stages to reduce NOx production.

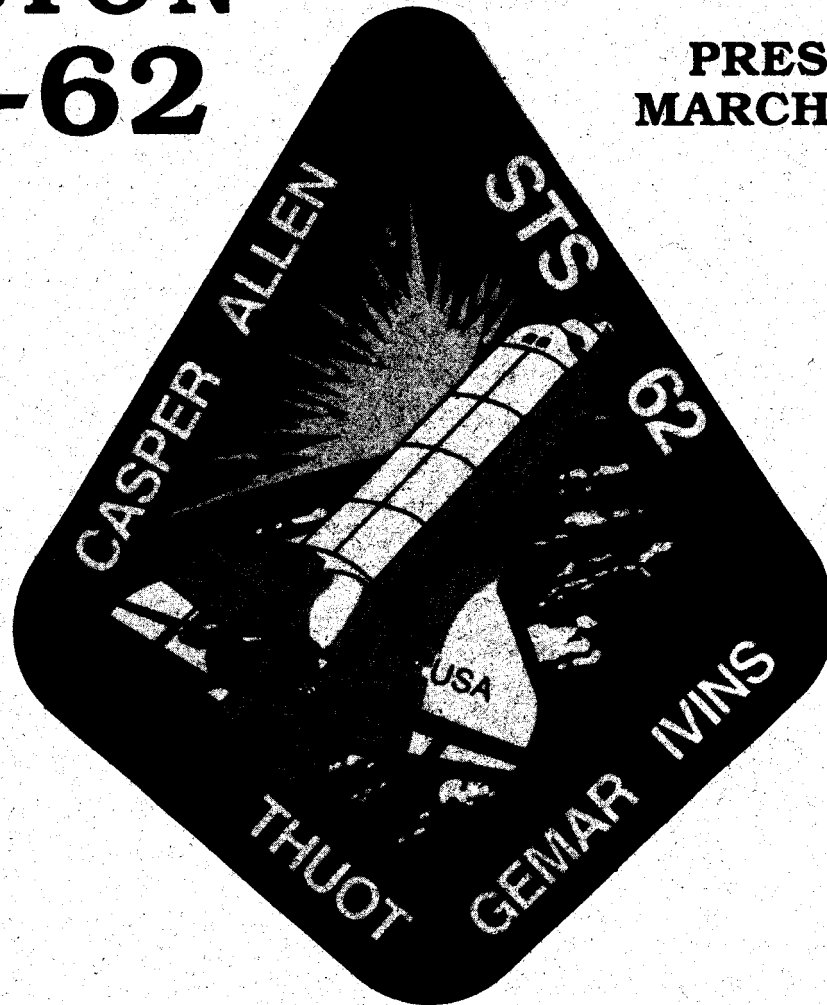
First, excess fuel is put into a small amount of air. This "rich burn" environment causes chemical reactions that minimize NOx emissions. As the mix flows through the combustor, more air is added and combustion is completed in a final fuel-lean burning stage. Experimental work with this concept has been started.

94-25

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SHUTTLE MISSION STS-62

PRESS KIT
MARCH 1994



UNITED STATES MICROGRAVITY PAYLOAD-2

OFFICE OF AERONAUTICS AND SPACE
TECHNOLOGY-2

SHUTTLE SOLAR BACKSCATTER ULTRAVIOLET
INSTRUMENT-A

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UNITED STATES MICROGRAVITY PAYLOAD MAKES SECOND FLIGHT

In a mission which reflects all the ways space exploration is helping reshape planet Earth, Shuttle Columbia is set to take off on a 2-week mission during which the five member crew will conduct dozens of experiments that run the gamut of space research -- from materials processing, to biotechnology, to advanced technology to environmental monitoring.

Leading the STS-62 crew will be Mission Commander John H. Casper who will be making his third space flight. Pilot for the mission is Andrew M. Allen who will be making his second space flight. Pierre J. Thuot is mission specialist 1 (MS1); Charles D. (Sam) Gemar is mission specialist 2 (MS2) and Marsha S. Ivins is mission specialist 3 (MS3) -- all of whom will be making their third space flights.

Launch of Columbia on the STS-62 mission currently is scheduled for no earlier than March 3, 1994, at 8:54 a.m. EST. The planned mission duration is 13 days, 23 hours and 4 minutes. Launch of Columbia at the opening of the window on March 3 would produce a landing at 7:58 a.m. EST on March 17 at Kennedy Space Center's Shuttle Landing Facility. STS-62 will be the 16th flight of Space Shuttle Columbia and the 61st flight of the Space Shuttle system.

The 14-day mission is the latest in a series of Extended Duration Orbiter (EDO) flights which will provide additional information for on-going medical studies that assess the impact of long-duration spaceflight, 10 or more days, on astronaut health, identify any operational medical concerns and test countermeasures for the adverse effects of weightlessness on human physiology.

The United States Microgravity Payload (USMP) will be making its second flight aboard the Space Shuttle. The USMP flights are regularly scheduled on Shuttle missions to permit scientists access to space for microgravity and fundamental science experiments which cannot be duplicated on Earth and provide the foundation for advanced scientific investigations that will be done on the international space station.

On USMP-2, two of the experiments will focus on studies which could lead to better, faster semiconductors. Another experiment will look at one of the most interesting areas of study in physics -- the critical point where a fluid is simultaneously a gas and a liquid -- to gather information on a fundamental theory which has widespread applications on Earth.

Another experiment will use the space laboratory to examine a phenomena that occurs on Earth -- the formation of dendrites -- which on Earth can determine the strength and durability of steel, aluminum and superalloys used in the production of automobile and aircraft components.

The six OAST-2 experiments will obtain technology data to support future needs for advanced satellites, sensors, microcircuits and the space station. Data gathered by the OAST-2 experiments could lead to satellites and spacecraft that are cheaper, more reliable and able to operate more efficiently.

STS-62 will help scientists calibrate sensitive ozone-detecting instruments with the sixth flight of the Shuttle Solar Backscatter Ultraviolet (SSBUV) Instrument. This highly calibrated tool is used to check data from ozone-measuring instruments on free-flying satellites -- NASA's Total Ozone Mapping Spectrometer (TOMS) and Upper Atmosphere Research Satellite (UARS) and the National Oceanic and Atmospheric Administration NOAA-9 and NOAA-11 satellites.

The Protein Crystal Growth (PCG) experiments and the Commercial Protein Crystal Growth (CPCG) experiments aboard Columbia will help scientists understand the growth of crystals to study the complex molecular structures of important proteins. By knowing the structure of specific proteins, scientists can design new drug treatments for humans and animals and develop new or better food crops.

NASA's efforts in the important field of biotechnology are represented by the fourth flight of the Physiological Systems Experiment which is designed to evaluate pharmaceutical, agricultural or biotechnological products, and the first flight of the Biotechnology Specimen Temperature Controller (BSTC), designed to test the performance of a temperature control device being developed for use with the Bioreactor, a cell-culture growth device. Also flying again on the Shuttle is the Commercial Generic Bioprocessing Apparatus (CGBA) payload which will support more than 15 commercial life science investigations that have application in biomaterials, biotechnology, medicine and agriculture.

The Middeck 0-Gravity Dynamics Experiment (MODE) will make its second flight on STS-62. MODE investigates how the microgravity of space flight influences the behavior of large space structures. The MODE test article can be configured in different shapes typical of space structural forms-- the truss of a space station, for example -- to help engineers develop and verify an analytical modeling capability for predicting the linear and nonlinear modal characteristics of space structures in a microgravity environment. MODE also will gather force measurements of nominal, crew-induced disturbance loads on the Shuttle.

Astronauts will demonstrate a new magnetic end effector and grapple fixture design for the Shuttle's Canadian-built robot arm that engineers believe will increase the arm's dexterity and alignment accuracy, provide operators with a sense of touch and allow the use of more compact "handles" on satellites and other Shuttle payloads.

- end -

MEDIA SERVICES INFORMATION

NASA Select Television Transmission

NASA Select television is now available through a new satellite system, Spacenet-2, Transponder 5, located at 69 Degrees West Longitude with horizontal polarization. Frequency is 3880.0 MHz, audio is 6.8 MHz.

The schedule for television transmissions from the Shuttle orbiter and for mission briefings will be available during the mission at Kennedy Space Center, Fla; Marshall Space Flight Center, Huntsville, Ala.; Dryden Flight Research Center, Edwards, Calif.; Johnson Space Center, Houston, and NASA Headquarters, Washington, D.C. The television schedule will be updated to reflect changes dictated by mission operations.

Television schedules also may be obtained by calling COMSTOR 713/483-5817. COMSTOR is a computer data base service requiring the use of a telephone modem. A voice report of the television schedule is updated daily at noon Eastern time.

Status Reports

Status reports on countdown and mission progress, on-orbit activities and landing operations will be produced by the appropriate NASA newscenter.

Briefings

A mission press briefing schedule will be issued prior to launch. During the mission, status briefings by a flight director or mission operations representative and when appropriate, representatives from the payload team, will occur at least once per day. The updated NASA Select television schedule will indicate when mission briefings are planned.

STS-62 QUICK LOOK

Launch Date/Site: March 3, 1994/Kennedy Space Center - Pad 39B
Launch Time: 8:54 a.m. EST
Orbiter: Columbia (OV-102) - 16th Flight
Orbit/Inclination: 160 nautical miles/39 degrees
Mission Duration: 13 days, 23 hours, 04 minutes
Landing Time/Date: 7:58 a.m. EST, March 17, 1994
Primary Landing Site: Kennedy Space Center, Fla.
Abort Landing Sites: Return to Launch Site - KSC, Fla.
TransAtlantic Abort landing - Ben Guerir, Morocco
- Moron, Spain
- Zaragoza, Spain
Abort Once Around - Edwards AFB, Calif.

Crew: John Casper, Commander (CDR)
Andrew Allen, Pilot (PLT)
Pierre Thuot, Mission Specialist 1 (MS1)
Sam Gemar, Mission Specialist 2 (MS2)
Marsha Ivins, Mission Specialist 3 (MS3)

Cargo Bay Payloads: United States Microgravity Payload-2 (USMP-2)
Office of Aeronautics and Space Technology-2 (OAST-2)
Dexterous End Effector (DEE)
Shuttle Solar Backscatter Ultraviolet/A (SSBUV/A)
Limited Duration Space Environment Candidate
Materials Exposure (LDCE)

In-Cabin Payloads: Protein Crystal Growth (PCG) Experiments
Physiological System Experiment (PSE)
Commercial Protein Crystal Growth (CPCG)
Commercial Generic Bioprocessing Apparatus (CGBA)
Middeck 0-Gravity Dynamics Experiments (MODE)
Bioreactor Demonstration System (BDS): Biotechnology
Specimen Temperature Controller (BSTC)

Other: Air Force Maui Optical Site Calibration Test (AMOS)

Detailed Test Objectives/Detailed Supplementary Objectives:
DTO 301D: Ascent Wing Structural Capability
DTO 307D: Entry Structural Capability
DTO 312: External Tank Thermal Protection
System Performance
DTO 319D: Orbiter/Payload Acceleration and
Acoustics Environment Data
DTO 413: On-Orbit Power Reactant Storage and
Distribution System Cryogenic Hydrogen Boiloff

DTOs/DSOs (cont'd): DTO 414: Auxiliary Power Unit Shutdown Test
 DTO 656: Payload and General Purpose Support
 Computer Single Event Upset Monitoring
 DTO 664: Cabin Temperature Survey
 DTO 667: Portable In-Flight Landing Operations Trainer
 DTO 670: Passive Cycle Isolation System
 DTO 678: Infrared Thermal Survey of Orbiter Crew
 Compartment, Spacelab and Spacehab Module
 DTO 679: Ku-Band Communications Adapter
 Demonstration
 DTO 805: Crosswind Landing Performance
 DTO 910: Orbiter Experiments Package-Orbiter
 Acceleration Research Experiment
 DSO 324: Payload On-Orbit Low Frequency
 Environment
 DSO 326: Window Impact Observations
 DSO 487: Immunological Assessment of Crewmembers
 DSO 492: In-Flight Evaluation of a Portable, Clinical
 Blood Analyzer
 DSO 802: Educational Activities
 DSO 901: Documentary Television
 DSO 902: Documentary Motion Picture Photography
 DSO 903: Documentary Still Photography

Extended Duration Orbiter Medical Project DSOs:

 DSO 603: Orthostatic Function During Entry,
 Landing and Egress
 DSO 604: Visual-Vestibular Integration as a
 Function of Adaptation
 DSO 605: Postural Equilibrium Control During
 Landing/Egress
 DSO 608: Effects of Space Flight on Aerobic and
 Anaerobic Metabolism During Exercise
 DSO 610: In-Flight Assessment of Renal Stone Risk
 DSO 611: Air Monitoring Instrument Evaluation
 Atmosphere Characterization
 DSO 612: Energy Utilization
 DSO 614: The Effect of Prolonged Space Flight on
 Head and Gaze Stability During Locomotion
 DSO 623: In-Flight Lower Body Negative Pressure
 Unit Test of Countermeasures and End-of-Mission
 Countermeasure Trial
 DSO 626: Cardiovascular and Cerebrovascular
 Response to Standing Before and After Space Flight

SPACE SHUTTLE ABORT MODES

Space Shuttle launch abort philosophy aims toward safe and intact recovery of the flight crew, orbiter and its payload. Abort modes include:

- * Abort-To-Orbit (ATO) -- Partial loss of main engine thrust late enough to permit reaching a minimal 105-nautical mile orbit with orbital maneuvering system engines.

- * Abort-Once-Around (AOA) -- Earlier main engine shutdown with the capability to allow one orbit around before landing at Edwards Air Force Base, Calif.

- * TransAtlantic Abort Landing (TAL) -- Loss of one or more main engines midway through powered flight would force a landing at either Ben Guerir, Morocco or Zaragoza or Moron, Spain.

- * Return-To-Launch-Site (RTLS) -- Early shutdown of one or more engines, without enough energy to reach Ben Guerir, would result in a pitch around and thrust back toward KSC until within gliding distance of the Shuttle Landing Facility.

STS-62 contingency landing sites are the Kennedy Space Center, Edwards Air Force Base, Ben Guerir, Zaragoza or Moron.

STS-62 SUMMARY TIMELINE

Flight Day One

Ascent
OMS-2 burn (163 n.m. x 160 n.m.)
USMP-2 activation
OAST-2 activation
APCG activation
Remote Manipulator System checkout
DEE operations
CGBA activation
SSBUV/A activation

Flight Day Two

SSBUV/A instrument activation
USMP-2 operations
OAST-2 operations
CPCG activation
PSE operations
LBNP operations

Flight Day Three

MODE operations
USMP-2 operations
OAST-2 operations
PSE operations
CPCG operations

Flight Day Four

LDCE operations
USMP-2 operations
OAST-2 operations
MODE operations
PSE operations
LDCE operations
PLT, MS2 off-duty (half-day)

Flight Day Five

CDR, MS1, MS3 off-duty
LBNP operations
MODE operations
USMP-2 operations
OAST-2 operations
PSE operations
CPCG operations

Flight Day Six

MODE operations
USMP-2 operations
OAST-2 operations
PSE operations
CPCG operations

Flight Day Seven

MODE operations
USMP-2 operations
OAST-2 operations
PSE operations
CPCG operations

Flight Day Eight

LBNP operations
USMP-2 operations
OAST-2 operations
MODE operations
LDCE operations
PSE operations
CPCG operations

Flight Day Nine

MODE operations
LDCE operations
USMP-2 operations
OAST-2 operations
PSE operations
CPCG operations

Flight Day Ten

Entire crew off-duty (half-day)
USMP-2 operations
OAST-2 operations
LDCE operations
PSE operations
CPCG operations

Flight Day Eleven

Orbital Maneuvering System-3 burn (157 n.m. x 140 n.m.)

Orbital Maneuvering System-4 burn (140 n.m. x 139 n.m.)

DEE operations

CGBA operations

OAST-2 operations

PSE operations

CPCG operations

Flight Day Twelve

LBNP operations

DEE operations

OAST-2 operations

PSE operations

CPCG operations

Flight Day Thirteen

Orbital Maneuvering System-5 burn (138 n.m. x 105 n.m.)

DEE operations

CGBA operations

OAST-2 operations

PSE operations

CPCG operations

Flight Day Fourteen

SSBUV/A deactivation

LBNP operations

Flight Control Systems checkout

Reaction Control System hot-fire

Secondary payloads deactivation

Cabin stow

Flight Day Fifteen

USMP-2 deactivation

OAST-2 deactivation

Deorbit preparations

Deorbit

Entry

Landing

STS-62 VEHICLE AND PAYLOAD WEIGHTS

Vehicle/Payload	Pounds
Orbiter (Columbia) empty and 3 SSMEs	181,299
United States Microgravity Package-2	9,606
Office of Aeronautics and Space Technology-2	5,789
Space Shuttle Backscatter Ultraviolet/A	1,073
Dexterous End Effector	693
Limited Duration Candidate Materials Exposure	1,203
Protein Crystal Growth (PCG) Experiments	135
Commercial Protein Crystal Growth	97
Commercial Generic Bioprocessing Apparatus	97
Middeck 0-Gravity Dynamics Experiments	186
Detailed Test/Supplementary Objectives	432
Total Vehicle at SRB Ignition	4,519,319
Orbiter Landing Weight	226,765

STS-62 ORBITAL EVENTS SUMMARY

EVENT	START TIME (dd/hh:mm:ss)	VELOCITY CHANGE (feet per second)	ORBIT (n.m.)
OMS-2	00/00:45:00	208 fps	163 x 160
OMS-3	09/16:45:00	38 fps	157 x 140
(first of two firings lowers Columbia's orbit for certain OAST-2 operations)			
OMS-4	09/17:30:00	32 fps	140 x 139
(completes lowering of Columbia's orbit for OAST-2 operations)			
OMS-5	11/18:08:00	59 fps	138 x 105
(further lowers one side of Columbia's orbit for OAST-2 operations)			
Deorbit	13/22:04:00	209	N/A
Touchdown	13/23:0600	N/A	N/A

STS-62 CREW RESPONSIBILITIES

TASK/PAYLOAD	PRIMARY	BACKUPS/OTHERS
USMP-2	Thuot	Gemar
OAST-2	Thuot	Ivins
DEE	Ivins	Thuot, Gemar
SSBUV/A	Thuot	Allen
LDCE	Thuot	Allen, Casper
Middeck Payloads:		
APCG	Thuot	Gemar
PSE	Gemar	Ivins
CPCG	Thuot	Ivins
CGBA	Ivins	Gemar
MODE	Gemar	Thuot
AMOS	Allen	Casper
BDS	Casper	Allen
Detailed Test Objectives/Detailed Supplementary Objectives:		
DTO 644	Allen	Casper
DTO 670	Allen	Casper
DTO 413	Allen	Casper
DTO 667	Allen	Casper
DTO 414	Allen	Casper
DTO 656	Ivins	Thuot
DTO 678	Ivins	Thuot
DTO 679	Ivins	Thuot
DTO 910	Gemar	Allen
DSO 603B	Thuot, Gemar, Ivins	
DSO 604	Casper, Allen, Thuot	
DSO 605	Allen, Thuot, Gemar, Ivins	
DSO 610	Casper, Gemar	
DSO 611	Ivins	
DSO 612	Casper, Gemar	
DSO 623	Allen, Gemar	Casper (operator)
DSO 324	Allen	Casper
DSO 326	Allen	Casper
Other:		
Photography/TV	Ivins	Thuot
In-Flight Maintenance	Allen	Gemar
EVA	Thuot (EV1)	Gemar (EV2), Allen (IV)
Earth Observations	Thuot	Allen
Medical	Allen	

UNITED STATES MICROGRAVITY PAYLOAD-2 (USMP-2)

The United States Microgravity Payload-2 (USMP-2) is the second in a series of missions to study the effects of microgravity on materials and fundamental sciences. USMP microgravity experiments are designed to be accomplished in the Space Shuttle payload bay. The Marshall Space Flight Center, Huntsville, Ala., manages USMP for NASA Headquarters Office of Life and Microgravity Sciences and Applications.

The USMP-2 mission consists of five experiments. The Advanced Automated Directional Solidification Furnace (AADSf) will study the directional solidification of semiconductor materials in microgravity. The Critical Fluid Light Scattering Experiment (also called Zeno) will measure the fluctuations of the density of xenon very near its liquid/vapor "critical point." The critical point occurs at a condition of temperature and pressure where a fluid is simultaneously a gas and a liquid with the same density.

The Isothermal Dendritic Growth Experiment (IDGE) is designed to test theories concerning the effect of gravity-driven fluid flows on dendritic solidification of molten materials. Materials for the Study of Interesting Phenomena of Solidification on Earth and in Orbit (MEPHISTO) will use several simultaneous measurement techniques in reduced gravity to investigate the precise nature of solidification.

The objective of the Space Acceleration Measurement System (SAMS) is to measure the components of the microgravity environment on the USMP carrier in support of the major experiments and to provide data for orbiter dynamic analysis studies.

In orbit, crew members will activate the USMP-2 experiments. On Earth, investigators at Marshall's Spacelab Mission Operations Control Center will command and monitor instruments and analyze data.

The Marshall-developed USMP carrier consists of two support structures that form a bridge across the payload bay. Experiment hardware is mounted on these support structures. Carrier subsystems mounted on the front structure provide electrical power, communications and data-handling capabilities and thermal control.

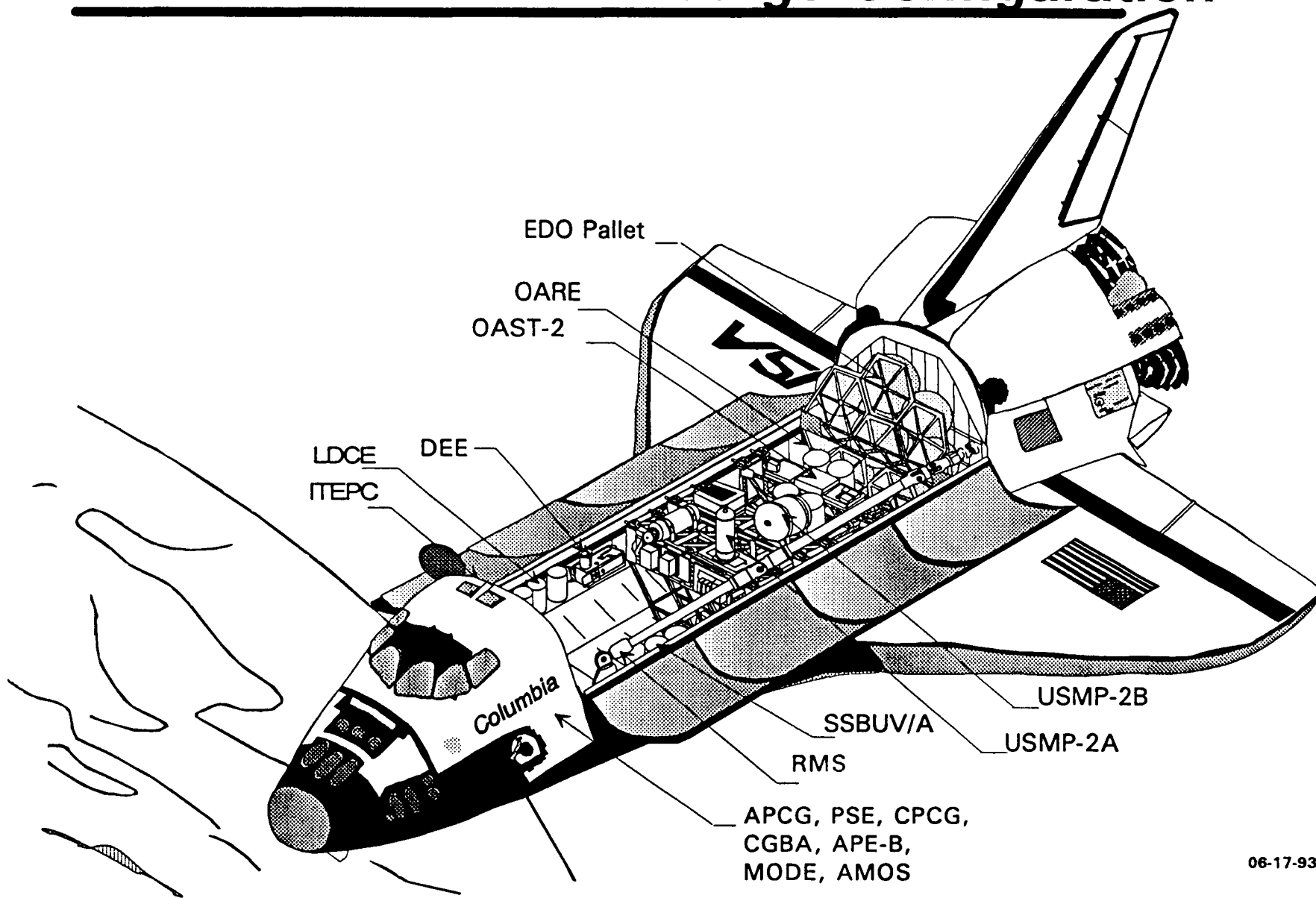
Advanced Automated Directional Solidification Furnace (AADSf)

Principal Investigator: Dr. S. Lehoczky
Marshall Space Flight Center, Huntsville, Ala.

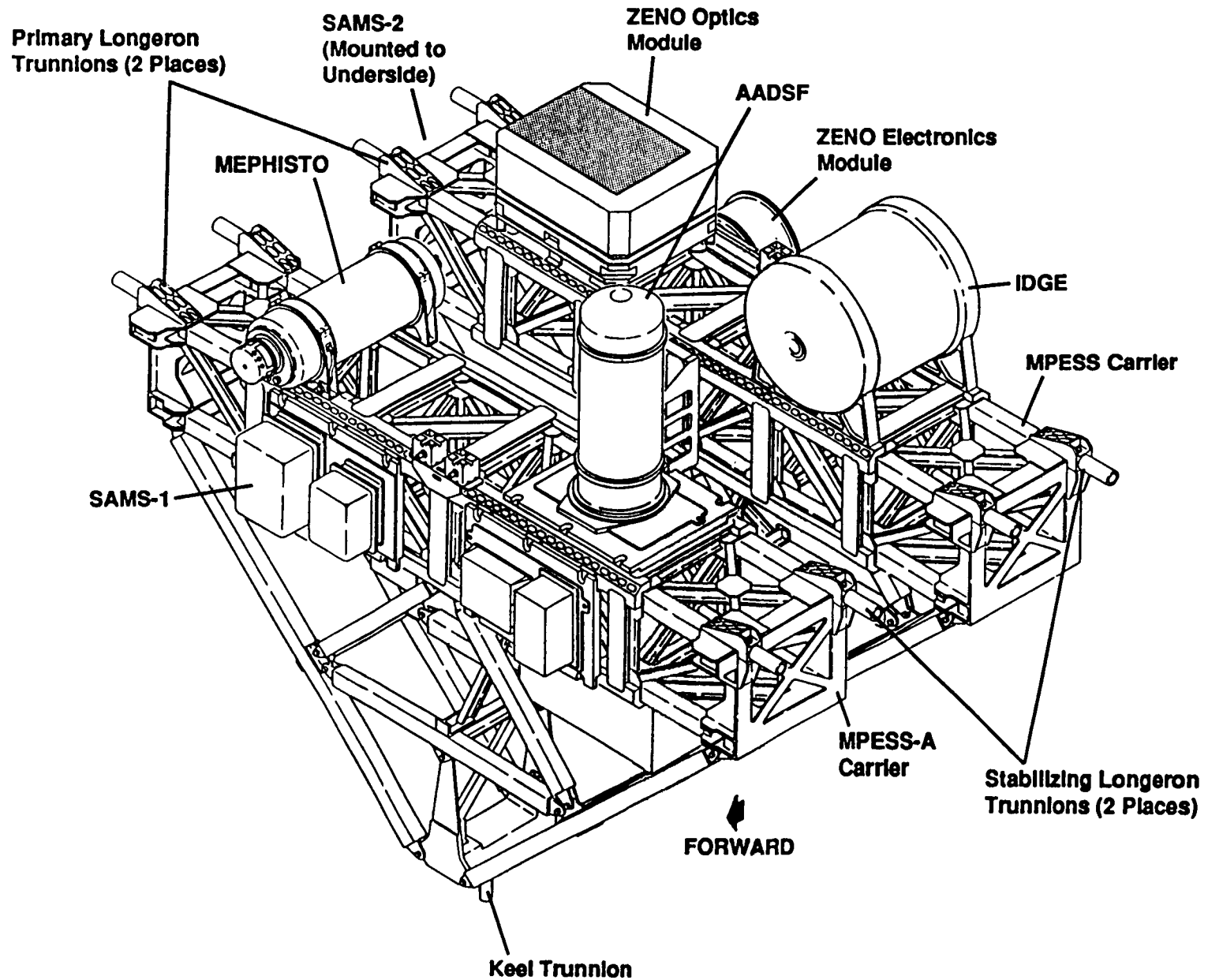
The Advanced Automated Directional Solidification Furnace (AADSf) will be used to study the directional solidification of semiconductor materials in microgravity. Data from these experiments will be used to verify theories about the effect of gravity on the chemical composition of growing semiconductors and also gravity's role in creating defects in semiconductor crystals.

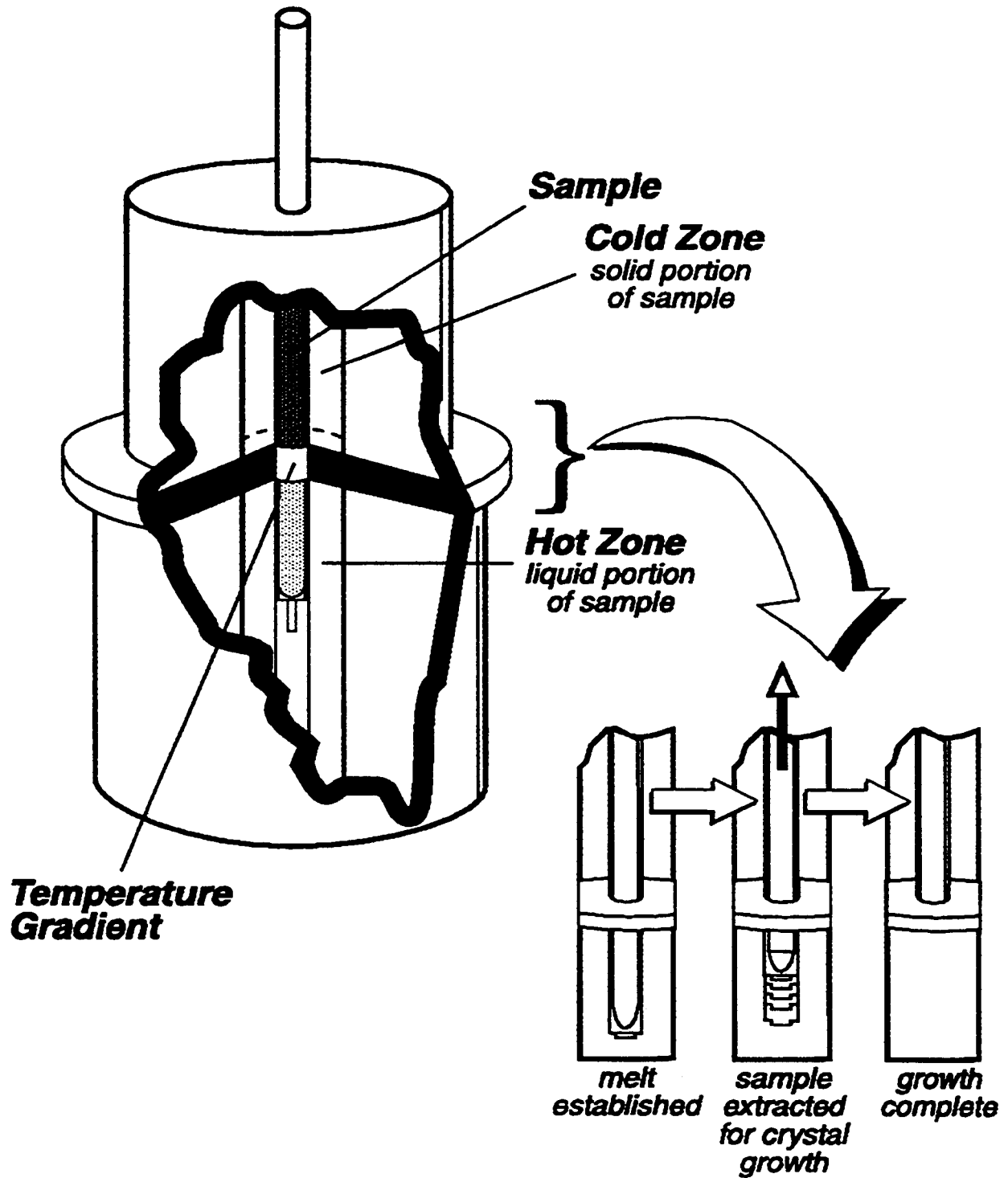


Space Shuttle Program STS-62 Cargo Configuration



06-17-93





AADSF Experiment

Crystals of semiconductor materials are used in everyday products such as computers, calculators and in high technology applications such as infrared detectors. The properties that make the crystals useful depend on the structural arrangement of the atoms inside and the distribution of the various chemical components which make up the semiconductor material. Suitable properties can be obtained by relatively fast cooling and solidification of most metals, but the electronic properties of semiconductor materials are extremely dependent on slow growth to obtain a high degree of crystal perfection and uniform distribution of the chemical constituents.

During the production of semiconductor crystals, gravity -- through convection (the buoyancy-driven flow of fluid caused by temperature differences) and settling of molten components -- can cause defects in this atomic structure. These gravity-induced imperfections cause problems ranging from physical flaws in the internal structure of the crystal to an uneven distribution of different components that make up the crystal. These defects can degrade properties required for the use of a particular crystal.

Using directional solidification, a technique commonly used to process metals and to grow crystals, AADSf will slowly process a cylinder-shaped sample of mercury cadmium telluride, a material used as an infrared radiation detector. The sample will be sealed in a container made of quartz. Inside a tubular furnace which has three temperature zones (each independently controlled), the sample will move from the "hot zone" (about 1600 degrees F) where the material stays molten, up to the "cold zone" (about 650 degrees F) where the material will solidify as it cools. The solidification region grows as the solid/liquid interface moves from one end of the sample to the other at a controlled rate, thus the term directional solidification.

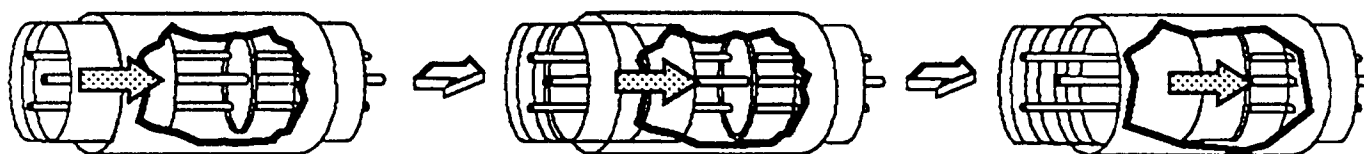
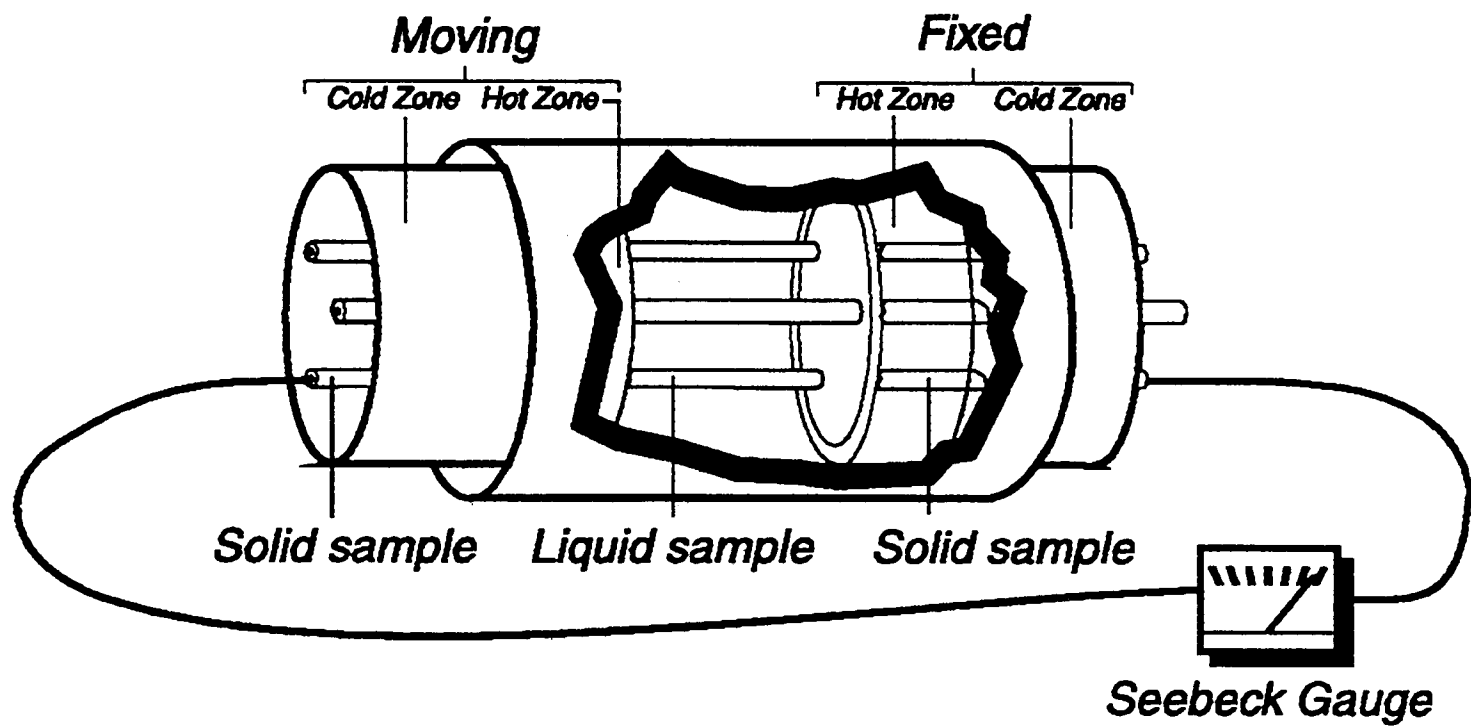
Scientists are particularly interested in the solid/liquid interface. It is here that the flows of molten material influence the final composition and structure of the solid and its properties. After the mission, scientists will analyze the solidified sample to determine the density of defects and the distribution of elements in the crystal.

Materials for the Study of Interesting Phenomena of Solidification on Earth and in Orbit (MEPHISTO)

U.S. Principal Investigator: Dr. R. Abbaschian, University of Florida, Gainesville

French Principal Investigator: Dr. J.J. Favier
Centre d'Etudes Nucleaires de Grenoble, Grenoble, France

MEPHISTO is flying for the second time on a USMP mission in a series of cooperative investigations between NASA and the French Space Agency (CNES). MEPHISTO studies the behavior of metals and semiconductors as



Moving furnace driven toward fixed furnace

MEPHISTO Experiment

they solidify. Results from MEPHISTO on USMP-2 will be compared with those gathered on USMP-1 which flew in October 1992.

Solidification processes become unstable under certain circumstances, such as convection caused by gravity. This instability causes changes to the structural properties of the resulting product. Scientists need to understand these gravity-driven phenomena in the solidification of metals, alloys and electronic materials. This information could result in improvements to production methods and materials on Earth.

To study this solidification phenomenon, scientists measure the temperature, velocity and the shape of the solidification front by melting and solidifying alloy samples. In USMP-1, melting and solidifying runs were conducted using alloy samples consisting of mostly tin with a small amount of bismuth. In USMP-2, the samples will consist mostly of bismuth with a small amount of tin. Although the samples are similar, they differ greatly in the way they solidify.

MEPHISTO will use a fixed furnace and a moving furnace simultaneously to process three identical rod-shaped samples of the bismuth-tin alloy. The fixed furnace provides a reference for the electrical voltages produced in the sample by the moving furnace. The moving furnace will be responsible for the actual melting and solidification of the samples. The second sample will determine the position of the solid/liquid interface, and the third sample will be marked with electrical current pulses that cause a momentary change in the local chemical composition which "outlines" the shape and position of the interface at that moment.

It is important to know the position of the interface and how fast it moves as the crystal is grown. Local conditions at the solidification front largely determine the crystal growth rate, crystal structure and composition. These factors in turn determine the quality of the crystal, its properties and its usefulness in electronic devices.

As a solidification run begins, the mobile furnace moves outward away from the fixed furnace, thus melting the samples. The mobile furnace then moves back towards the fixed furnace and the sample resolidifies. The MEPHISTO apparatus allows many solidification and remelting runs and is particularly well suited for long-duration missions.

During STS-62, MEPHISTO data will be correlated with data from the Space Acceleration Measurement System (SAMS). By comparing the data, scientists can determine how accelerations and vibrations aboard the Shuttle disturb the solid/liquid interface.

On USMP-1, scientists found regular cellular patterns in the structure of the alloy at or near the point where the solidification becomes unstable. This is important because if these patterns can be predicted and controlled, the mechanical and electrical properties of the materials can be better controlled as well.

In addition, USMP-1 afforded researchers the opportunity to see what effect, if any, Shuttle movement and crew activity had on the growing crystals. Using the SAMS instrument, researchers found that buoyancy-driven convection from accelerations such as crew motion did not affect the solidification at the growth rates used for most of the MEPHISTO runs. Scientists also found that larger accelerations did have an effect on the quality of the crystal, and they were able to measure and study their impact.

Isothermal Dendritic Growth Experiment (IDGE)

Principal Investigator: Dr. M. Glicksman, Rennselaer Polytechnic Institute, Troy, N.Y.

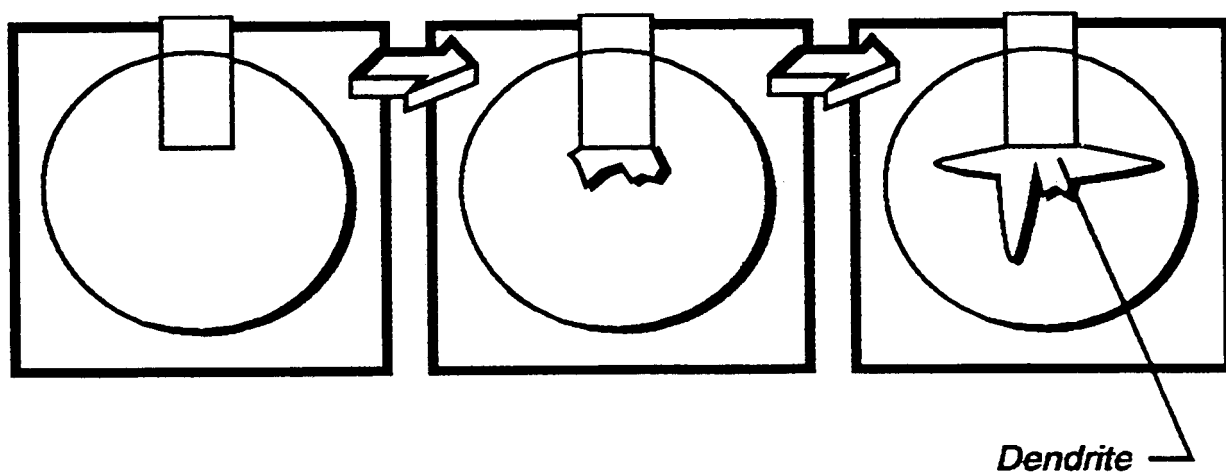
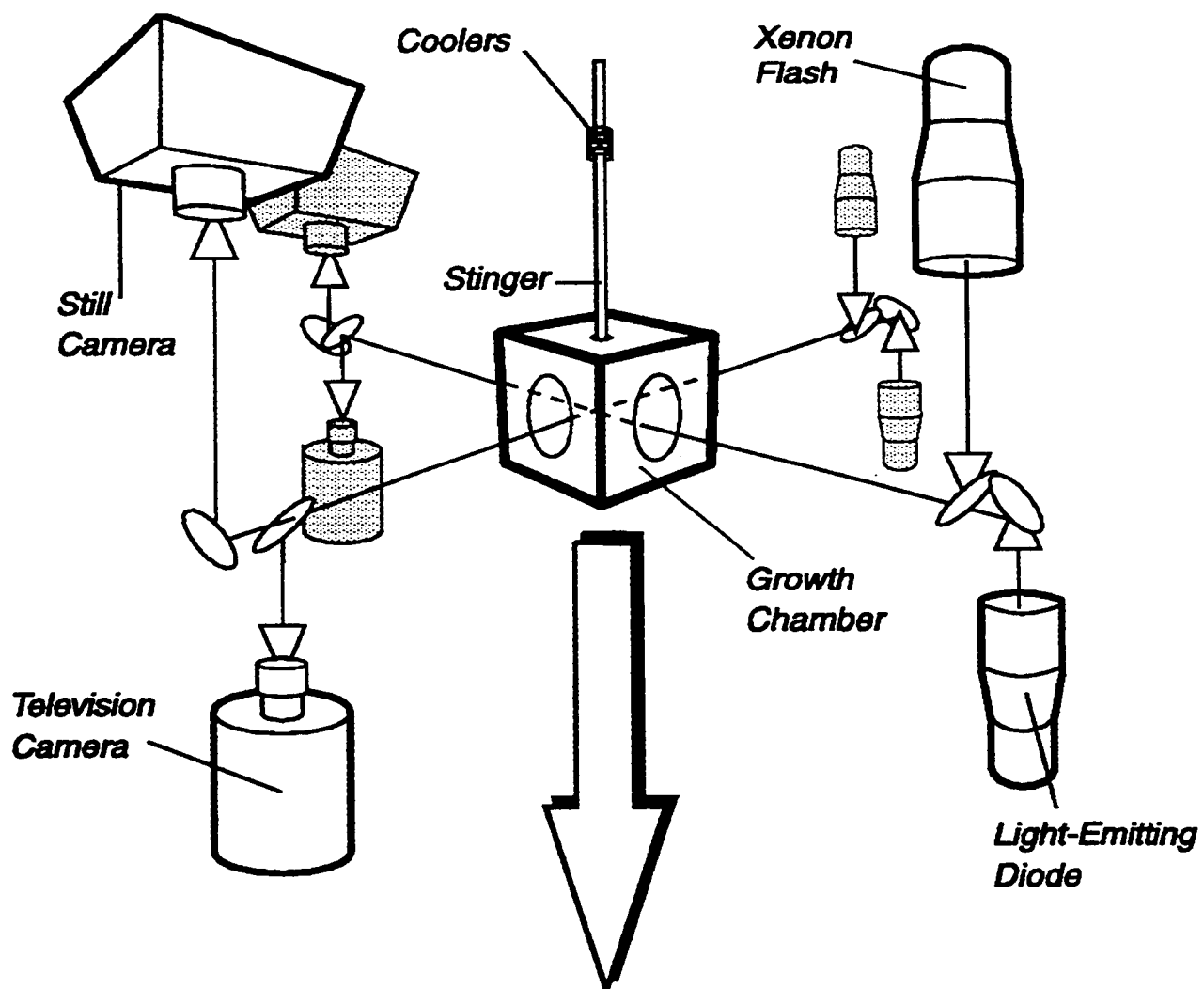
Dendrites are crystalline forms that develop as materials solidify under certain conditions. Snowflakes are an example of dendritic solidification, forming beautiful tree-like patterns as they develop.

Most metal products that we use in our society are commonly solidified under conditions that form dendrites. When dendrites form, their size, shape and the direction in which they develop can determine the strength and durability of steel, aluminum and superalloys used in the production of cars and airplanes.

On Earth, gravity causes convective fluid flows in molten metals during solidification, thus affecting the characteristics of the final product. Scientists are interested in studying the size and shape of the dendrite branches and how they interact with each other. This can be more easily accomplished without the interference of gravity-driven convection. Because most industrially important alloys solidify from a molten state by dendritic processes, gaining a better understanding of how these processes work may help improve industrial production techniques.

The Isothermal Dendritic Growth Experiment (IDGE) will use the material succinonitrile (SCN) to study dendritic solidification of molten materials in the microgravity environment of space. SCN mimics the behavior of solidifying metal alloys, but is transparent, allowing photography of the dendrites. The IDGE principal investigator will compare photographs of space-grown dendrites with photos of those grown on Earth.

IDGE hardware consists of a thermostat that contains the dendrite growth chamber and a hollow tube connected to coolers on the outside of the chamber. Prior to the flight, the growth chamber is filled with ultra-pure SCN. The tube also will be filled with SCN, and it will be placed in the growth chamber. As the coolers lower the temperature of the SCN in the hollow tube, the material begins to solidify. The solidification front moves down the tube shaft to the tip of the tube where it emerges as an individual dendrite into the growth chamber and the SCN.



Two 35mm cameras photograph the emerging dendrites during growth. Video downlink from the experiment is also transmitted to the IDGE science team on the ground.

Critical Fluid Light Scattering Experiment-Zeno (CFLSE-Zeno)

Principal Investigator: Dr. R. Gammon, University of Maryland, College Park

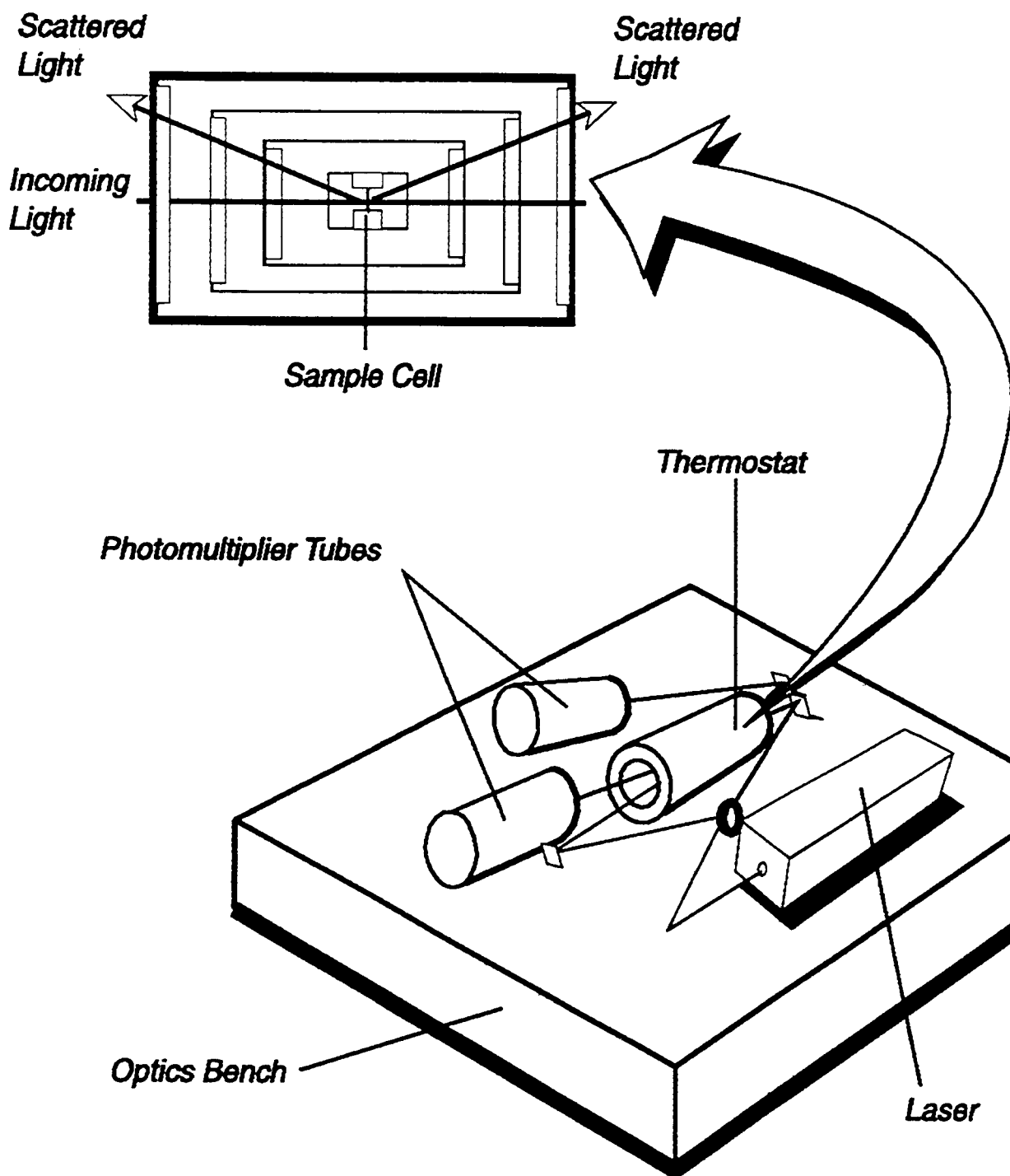
Onboard USMP-2 the Critical Fluid Light Scattering Experiment-Zeno is designed to study the behavior of xenon at its "critical point." The critical point occurs at a condition of temperature and pressure where a fluid is simultaneously a gas and a liquid with the same density. Zeno will measure properties of xenon much closer to its critical point than is possible on Earth. This will be accomplished by minimizing the density driven separation due to gravity on Earth.

An example of a phase transition is water changing to steam when its temperature is increased beyond 212 degrees Fahrenheit (100 degrees Celsius). During this transition, the water goes through a density change as well. The steam is much less dense than the water. If the water's pressure is increased beyond sea-level pressure it will boil at a higher temperature and be more dense when it changes to vapor. At the "critical point," there is no difference between the liquid and vapor states. An example of the commercial use of critical point phenomenon is the removal of caffeine from coffee using water at its critical point. By using water in this critical stage instead of methylene chloride, a potential cancer risk has been removed from the decaffeinated coffee and a hazardous waste product eliminated.

The critical point is difficult to study on Earth because gravity distorts the density of the samples, and the weight of the column of fluid compresses the lower part of the sample until its density is greater than the critical density. The sample literally collapses under its own weight. When this occurs, it leaves only a very small area for scientists to study, giving them an unclear picture of the transition. In reduced gravity, the critical zone will be "widened" thus giving scientists a much "crisper" picture of the critical point phenomenon.

Because many different materials we use on Earth share this phenomenon, scientists are particularly interested in the critical point. Materials at the critical point will exhibit behavior that does not occur under any other circumstances. Some systems that are different physically will act similarly when they are near their critical points. Scientists hope understanding the physics near the critical point will help provide insight into a variety of physics problems in solids, liquids and gases.

In the USMP-2 experiment, a tiny sample of ultra-pure xenon will be housed inside a high-precision thermostat, where it will be kept near its critical density. The Zeno instrument then will "search" for the critical temperature of the sample.



As the xenon approaches its critical point, patches of the normally clear gas will become cloudy (much like water from a faucet with an aerator on it, caused by the intermingling of minute gas droplets within a liquid) as microscopic portions of the sample pass through the critical point and back again. Closer to the critical point, these areas will become larger and exist for longer periods.

When a laser light is passed through the sample at temperatures successively closer to the critical temperature, the light is scattered by these cloudy areas. Two detectors measure these fluctuations, and scientists will use the data gathered to determine how large the areas are and how long they exist in relation to temperature changes near the critical point.

Space Acceleration Measurement System (SAMS)

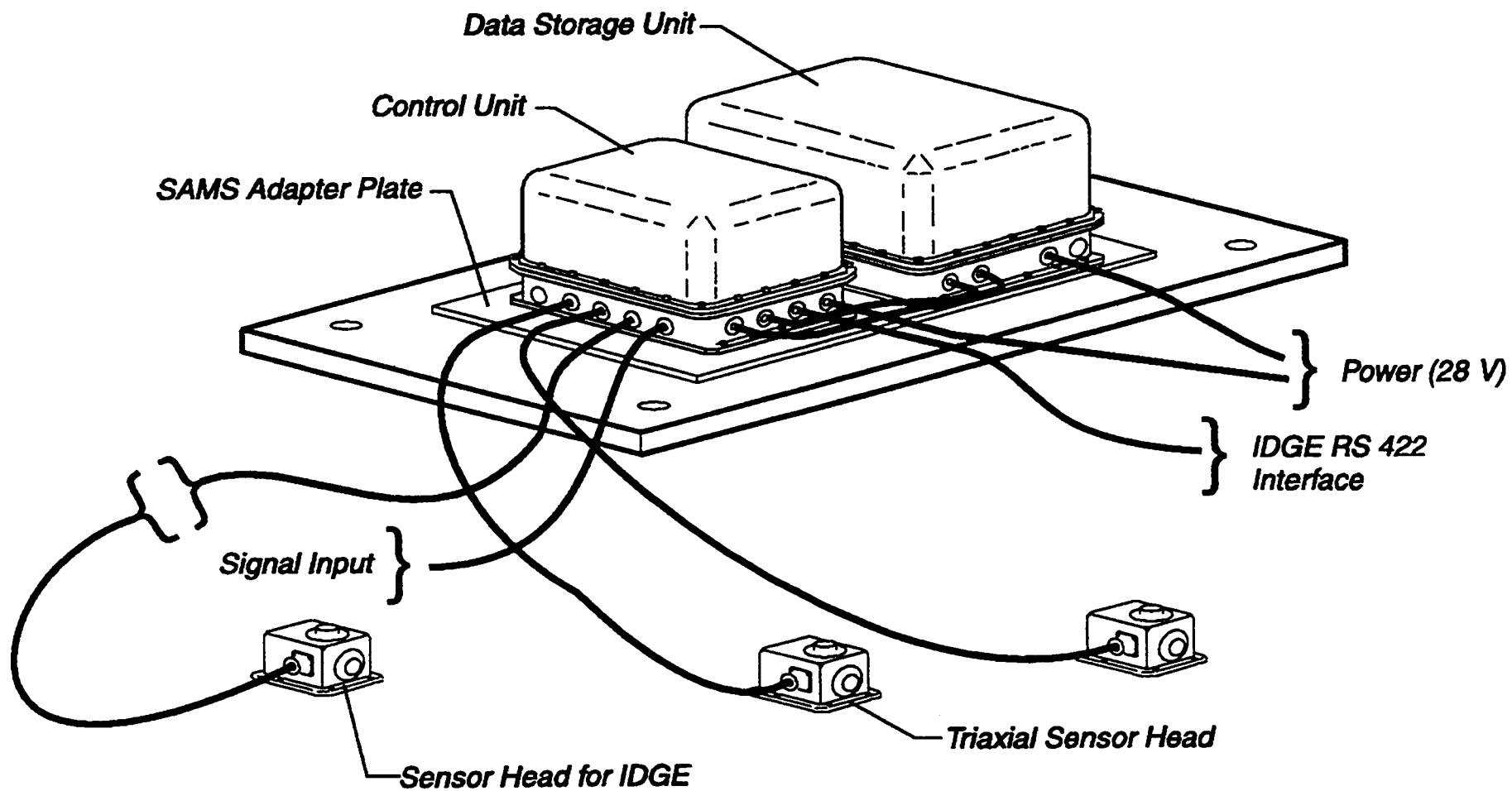
Project Manager: C. Siegert, NASA Lewis Research Center, Cleveland

The Space Acceleration Measurement System (SAMS) instrument monitors and records onboard accelerations and vibrations experienced on orbit during a Shuttle flight. The effects of Earth's gravity are greatly reduced, but not eliminated. Such influences as crew activity, Shuttle maneuvers and the slight atmospheric drag on the Shuttle can create disturbances that mimic gravity. Although these are slight, they can affect the highly gravity-sensitive science experiments onboard.

Using sensors called accelerometers, SAMS takes measurements of these disturbances and transmits them to scientists on the ground where they can make adjustments to improve their results if the disturbances are significant. Data also are recorded for post-mission analysis. Based on data analysis, scientists can learn what kinds of disturbances affected their experiments, and they can make new designs for future missions which take these into account.

SAMS also will support orbiter studies. SAMS acceleration data recorded during orbiter maneuvers will be used to verify existing Shuttle structural dynamic models.

SAMS consists of electronics packages and remote sensor heads. Four of the sensor heads are placed on the USMP carrier (two on the front structure and two on the back structure). A fifth sensor is mounted within the Isothermal Dendritic Growth Experiment instrument. Data from this head are pre-processed by the SAMS unit and returned to the experiment computer to support IDGE scientific analysis. Each SAMS sensor consists of three single-axis acceleration sensors connected to the SAMS electronics package with cables. Each sensor produces signals in response to accelerations. Electronics amplify and filter the signals, then convert them into digital data.

**SAMS-2 Apparatus**

OAST-2

The overall objective of this payload is to obtain technology data to support future needs for advanced satellites, sensors, microcircuits and the international space station.

There are six In-Space Technology Program (INSTEP) experiments mounted on a Hitchhiker carrier. The six experiments and their overall mission objectives are:

Solar Array Module Plasma Interaction Experiment (SAMPIE) - Determine the arcing and current collection behavior of different types, sizes and shapes of solar cells, solar modules and spacecraft materials.

Thermal Energy Storage (TES) - Determine the microgravity behavior of two different thermal energy storage salts that undergo repeated melting and freezing.

Experimental Investigation of Spacecraft Glow (EISG) and Spacecraft Kinetic Infrared Test (SKIRT) - Develop an understanding of the physical processes leading to the spacecraft glow phenomena by studying infrared, visible and far-ultraviolet light emissions as a function of surface temperature and orbital altitude.

Emulsion Chamber Technology (ECT) - Measure background cosmic ray radiation as a function of shielding and radiation energy photographic films.

Cryogenic Two Phase (CRYOTP) - Determine the performance of microgravity nitrogen space heat pipe and cryogenically-cooled, vibration-free, phase-change-material thermal storage unit thermal energy control technologies.

The Hitchhiker carrier used to support the OAST-2 experiments is commonly referred to as a Mission Peculiar Equipment Support Structure (MPRESS). The carrier sits across the orbiter's payload bay. It also includes an onboard avionics control box which provides electrical, telemetry and command and control interface between the orbiter and the experiment packages.

The SAMPIE, EISG, SKIRT and CRYOTP payloads will be operated by teams of principal investigators through the Goddard payload operations control center. The only experiment mounted on the Hitchhiker which is not controlled through the avionics box located on Hitchhiker is the Thermal Energy Storage experiment. It is operated from a laptop computer setup by the crew in the aft flight deck. Because of its completely passive nature, the ECT experiment has no commanding functions and does not downlink data to the GSFC POC.

Four of the experiments on the OAST-2 Hitchhiker will investigate the interaction between orbiting spacecraft and the space environment. These four are the SAMPIE, EISG, SKIRT and ECT. The other two (TES and CRYOTP) will investigate spacecraft thermal control and storage technologies.

The Office of Advanced Concepts and Technology is the program office responsible for the OAST-2 payload. Payload integration was performed by the Goddard Space Flight Center, which is also responsible for project management. The GSFC Project Manager is Neal Barthelme. The OAST Program Manager is Mark Nall. Overall payload development and operations costs, including the Hitchhiker carrier and integration, total \$30 million including \$500,000 of U.S. Air Force development funds for the CRYOTP experiment.

Solar Array Module Plasma Interaction Experiment

The Solar Array Module Plasma Interaction Experiment (SAMPIE) will investigate the plasma interactions of high voltage space power systems with the space plasma in low Earth orbit (LEO).

Modern satellites and spacecraft have become larger, heavier and more sophisticated to the point that they now require higher operating voltages. Although LEO does not have an atmosphere in the classic sense, it still contains widely spaced atoms of oxygen and nitrogen which have become ionized and are contained in a plasma layer in the region in the first few hundred miles above the Earth's ionosphere. Spacecraft voltage can potentially interact with these atoms in space causing arcing problems between spacecraft components. This experiment will investigate and quantify the interaction of high voltage surfaces with the surrounding space environment.

Numerous ground and flight experiments already have shown there are two basic interactions with the surrounding plasma when spacecraft surfaces are at a high voltage relative to that of the plasma. One type of interaction occurs when conducting surfaces, whose electrical voltage is highly negative compared to the plasma, undergo arcing which damages the material and disrupts normal spacecraft electrical operations. This is similar to the lightning which occurs in cloud-to-cloud strikes. The other type of interaction occurs when a surface voltage is highly positive with respect to the surrounding plasma. In that case, the spacecraft surface collects vast quantities of electrons resulting in a loss of power.

The overall objectives of the SAMPIE experiment are to investigate the arcing and current collection behavior of different materials and shapes. Traditional ground-based plasma tests have provided useful data but have never satisfactorily duplicated the in-orbit space plasma environment. SAMPIE will allow ground-based test data to be verified and validated as well as providing complete sets of data on arcing and current flow.

The SAMPIE test setup creates an environment suitable for arcing to occur. The instruments will detect occurrences of arcing and will measure the arc rate. The experiment hardware consists of a metal box with an experiment plate affixed to the top surface. The container houses the electronics subsystems which consist of a power supply to bias the solar cell samples to 600 volts (as measured from the plasma ground), an electroscope to measure current collection, the arc measurement system, the plasma diagnostic and measurement system and a data interface unit. The data from the experiment will be both stored onboard and transmitted to the Payload Operations Control Center at the Goddard Space Flight Center.

The experiment plate provides the mounting surface for all the experiment samples. The test samples consist of four types of solar cells and two additional sample materials for special purpose arcing experiments. The solar cells represent a variety of existing and in-development materials, representing several technologies. Each of the samples will be biased to high voltages to characterize both negative potential arcing and positive potential current collection.

The solar cell types to be tested are:

- Space Station Cells -- a 4-cell sample of space station cells, having copper interconnects in the back, will test this technology. Arcing is expected to occur from the cell edges. There is considerable interest in both the arcing characteristics and the current collection of these cells.
- Advanced Photovoltaic Solar Array -- a sample blanket of this material will test the behavior of this relatively new, very thin cell technology. The array uses germanium-coated Kapton for protection against oxidation from the atomic oxygen.
- Standard Silicon -- this type of solar cell has been used exclusively in the U.S. space program and will provide a baseline for comparison with the other test materials.
- Modified Space Station -- three samples of this material are designed to test a known set of factors about these cells which significantly affect their behavior in plasma interactions.

In addition to the four samples of solar cells cited above, there are two specific tests which will investigate multiple breakdown and single breakdown arcing events. For the multiple breakdown test, five metallic samples will be tested in an identical configuration with only the metal being changed. The test metals are gold, silver, copper, aluminum and tungsten.

The single breakdown test will use anodized aluminum samples to determine if the material undergoes a breakdown when subjected to high voltage arcing conditions.

Approximately 24 hours of experiment time are planned with the payload bay pointed in the direction of orbital travel (ram-side) and another 12 hours with the payload bay pointed away from the line of flight (wake-side). The mounting scheme for the plasma current and plasma potential (volts) probes places the probes out of the plasma sheath which forms during experiment operation and provides for an accurate plasma data measurement and an accurate measure of the Shuttle's plasma potential (voltage potential between the orbiter and an object in the payload bay).

The specific objectives for this experiment are:

- Determine the plasma current collection and arcing characteristics on an array of solar photovoltaic cells made from traditional silicon materials, from an array of solar cells using an advanced material and from a set of cells representing those which will fly aboard the space station.
- Determine collection current characteristics on a sample of anodized aluminum coating with Z93 paint used to support the space station program.
- Collect arcing data on solar modules specifically to preclude arcing in low Earth orbit.
- Determine collection current characteristics on simple metal/insulator geometries and arcing characteristics on various metal samples of controlled design.
- Measure a basic set of plasma parameters during the flight period.
- Using test results obtained in the observations cited above, validate the existing NASA space plasma and spacecraft charging computer models.

The minimum success criteria for this experiment will be the successful collection of current (amperage) data in the bay-to-ram operation mode, successful collection of data on the space station solar cell and standard solar cell samples and successful collection of data on the anodized aluminum sample. A fully successful experiment will be the result of data collection through the entire set of planned sequences.

The experiment hardware and testing procedures were developed by NASA Lewis Research Center, Cleveland. Sverdrup Technology, Inc., is providing engineering support. Lawrence Wald, LeRC In-Space Technology Branch, Space Experiments Division, is the experiment manager.

Thermal Energy Storage

The Thermal Energy Storage (TES) experiments are designed to provide data about the microgravity behavior of thermal energy storage salts which undergo repeated freezing and melting. This type of data has never been obtained before and has a direct impact on the development of on-orbit energy storage systems.

These power systems to be tested will store collected solar thermal energy in a salt which is contained in vacuum-sealed containers. As the salt absorbs the thermal energy, it melts. When the thermal salt is melted, it expands by about 30 percent. When it is cooled, the salt solidifies and shrinks, creating voids or pockets in the salt. This void formation within the salt affects the heat absorption rate of the salt and the design of the heat receiver containers holding the salt. These tests will assist in the development of future solar dynamic power receivers being considered for space station.

The two experiment components (TES-1 and TES-2) are self-contained autonomous payloads which will be placed inside Get Away Special (GAS) containers. The GAS containers are mounted along with the other experiments on the Hitchhiker MPRESS carrier.

Each TES component occupies 5-cubic feet of the container and weighs 245 pounds. The payloads placed inside each container consist of identical sets of subsystems -- the top section of each container holds the experiment subsystem, the middle section contains the data acquisition and command and control subsystem along with experiment temperature control electronics and the bottom section contains a battery box containing 23 silver-zinc cells and a power conditioning unit.

The experiment sequence for each of the two payloads calls for four thermal cycles. The contained salts are melted and refrozen for each thermal cycle. Minimum success criteria call for one melt/freeze cycle for each of the two systems. The experiment protocol calls for a 5-hour heat up period, 10 hours for completing the four thermal cycles and a cooldown period. The thermal storage material for TES-1 is lithium fluoride, which melts at 1121 Kelvin. The material used in TES-2 is lithium fluoride/calcium difluoride eutectic, which melts at 1042 Kelvin. The experiments are deactivated at a time when the experiment section has cooled down to about 750 Kelvin.

The specific experiment objectives are:

- Determine the long duration low-gravity behavior of void shape and location in lithium fluoride based thermal energy storage materials that have application to solar dynamic power systems on spacecraft.

- Provide flight data that will be correlated with analytical computer code predictions for the behavior of lithium fluoride based salts in a 1-g and low-g microgravity environment.

The flight experiment hardware and testing procedures were developed by an in-house dedicated project team consisting of NASA Lewis Research Center and Sverdrup Technology, Inc. engineers and technicians. Project management and scientific oversight was performed by Andrew J. Szaniszlo in the In-Step Payload Development Branch of the Space Experiments Division at LeRC.

Investigation of Spacecraft Glow and Kinetic Infrared Test

The Experimental Investigation of Spacecraft Glow (EISG) and Spacecraft Kinetic Infrared Test (SKIRT) experiments will investigate the phenomenon known as spacecraft glow. This is an aura of light created around the leading or front-facing surfaces of all spacecraft as they orbit Earth. Oxygen and nitrogen form molecules in excited states when the spacecraft rams into them at high velocity.

These molecules give off light as they decay to their lower energy levels, thus causing the glow. This glow can interfere with data collected by optical and other instruments that record specific wavelengths of photon energy.

These two experiments will measure gas-phase and surface glow emissions as a function of different orbital altitudes, attitudes and temperature of the surface of the test object. These glows will be studied under various thermal, orbital attitude (ram versus wake) and atmospheric conditions. Of particular interest is the study of the interaction of natural atmospheric constituents with the fast moving spacecraft.

Pressurized nitrogen gas containers are mounted beneath the sample plate on the EISG instrument and will be used during the observations as a source of ionizing atoms for the tests.

The EISG includes 530 pounds of hardware including the sample plate and electronics packages. There is an optical diagnostic instrument set which views the 1-x-1 meter sample plate. Samples include common white and black paints (Z306 and Z276 Chemglaze) used as thermal and baffle paint coatings. The coatings are applied to 10-mil metal substrates which are insulated from attachment structures so they can be radiatively cooled.

A steering mirror directs the instruments to different sections of the sample plate. The mirror is used to direct optical observations to the Visible Imaging Spectrometer (VIS) and the Far Ultraviolet Spectrometer (FUV). These instruments cover the range from 4200-8200 angstroms (VIS) to 1400-3600 angstroms (FUV) and will gather spectral data of the samples at varying oblique incident angles looking directly at the plate to looking above the plate.

A different set of sensors will gather data directly over the sample plate. These sensors will gather data in the infrared in two regions (1-3 microns and 3-5.4 microns) and are cooled detectors. Nitrogen gas tanks will supply the source material for a series of experiments using ionization of nitrogen as the plasma. Orbital operations on the Shuttle are planned which include 7 dedicated highly elliptical orbits and 4 orbits at 140 nautical miles circular so studies of the plasma interaction can occur at varying altitudes down to 105 nautical miles.

Most of the data produced by the two spectrometers and infrared sensors will be recorded onboard the EISG tape recorders. Some of the data will be downlinked during the mission for analysis by scientists at Goddard's POCC.

This experiment aims to develop an understanding of the physical processes which lead to spacecraft glow phenomena with an emphasis on surface temperature of test samples as related to the effects of spacecraft altitude. Optical diagnostic packages are used which cover the far-ultraviolet, the visible and the infrared regions of the spectrum. The instruments have been optimized for observations in the spectral regions associated with the glow phenomena.

Orbital experiment protocol for the EISG requires a 3-hour period for initial experiment and functional system checks. Flight tests will be conducted on seven dedicated orbits which have attitudes optimized for investigations into the thermal, altitude and release effects while the experiment's optical diagnostic sensors are taking readings above both material samples alternately. Shuttle glow data will be taken on shadow portions of the orbits for periods of about 30 minutes for a total of 3 and one-half hours of shadow glow data.

In addition to the planned sequences, the EISG instruments also will be operated during periods of orbiter and crew opportunity to study spacecraft glow and luminosities from thruster effluents and Earth atmospheric airglows.

SKIRT is a circular variable filter infrared spectrometer contained in a GAS can and cooled by solid nitrogen to a temperature of 57 degrees Kelvin. As the spectrometer is rotated, the instrument obtains a spectral reading every 5 seconds covering the 0.6 to 5.3 micron infrared range. There also is an aperture on the instrument which allows a reading to be taken of the space directly overhead the payload bay.

The SKIRT sensors will obtain infrared data during all observations using the visible and ultraviolet sensors on the EISG. In addition, SKIRT will have six dedicated maneuvers for observations, four involving orbiter nose-down rolls and two involving lunar calibrations. The SKIRT also will be used whenever possible during other mission operations.

The SKIRT experiment can take data during both day and night orbit cycles, during thruster firings and during lunar illumination. The instrument will avoid taking readings during orbiter water dumps, orbital maneuvering system firings, direct sunlight and direct ram exposure.

The specific experiment objectives are:

- Characterize the glow intensity with ram (in the direction of flight) atmosphere and to study the variation of cold and warm samples.
- Characterize the glow as a function of altitude by studying the altitude effects of the glow specimens through stepped circular and elliptical orbits of the Shuttle.
- Characterize the glow intensity and spectra as it is modified by the active chemical release of gaseous nitrogen into the ram atmosphere.
- Characterize the glow for the two specific samples, i.e., Z306 and A276 coatings.
- Study the entire glow process by observing ultraviolet, visible and infrared glow simultaneously.

Data will be sent to the Goddard POCC and will be reduced at Goddard in realtime during the mission.

The experiment hardware and procedures were developed as a joint program by NASA Johnson Space Center, Lockheed Palo Alto Research Laboratory, Lockheed Engineering and Sciences Co. and the Department of Defense (U.S. Air Force Phillips Laboratory). G. Swenson of Lockheed is the Principal Investigator for the experiment. M. Ahmadjion is the Phillips Lab Project Manager.

Emulsion Chamber Technology

The Emulsion Chamber Technology (ECT) experiment will test the sensitivity of photographic materials, used as detectors for cosmic ray analysis, to deterioration effects from heat, mechanical vibration and unwanted background radiation.

This test will evaluate detectors and methods of using calorimetric photographic stacks as orbital high energy cosmic ray detectors during the later stages of this decade. This technology has the potential for achieving many of the astrophysics high energy cosmic ray objectives at a fraction of the cost of large electronic calorimeters. This experiment will gather data which will help assess the ability of the new detectors to withstand longer exposures without losing the capacity to extract data from the detectors after the flight.

New space radiation dosimetry data also will be obtained on high shielding depths, allowing precise tests of the radiation transport model and the dose calculation model presently used by NASA scientists.

The hardware consists of a stack of photographic films of unique design encased in a hermetically sealed aluminum box at normal atmospheric pressure. The film stack consists of x-ray film, lead plates and dosimetry detectors stacked together. Internal temperatures and pressures of the stack are monitored and recorded. Because the cosmic ray detectors are entirely passive, this experiment tracks incidences of cosmic ray abundance throughout the entire mission.

The mission objectives of this experiment are:

- Assess the ability of emulsion calorimetry methods to be used for long periods in space to achieve NASA objectives in cosmic ray astrophysics and high energy nuclear particle physics.
- Determine the retrieval efficiency of cosmic ray spectra above 1 TerraVolt per nucleon and compare this with prior balloon flight results.
- Measure all components of the space radiation background and secondary or induced radiation. These measurements will be compared with calculations to develop models which can predict the conditions which would occur on longer exposure flights.
- Obtain comprehensive dosimetry data for a well-defined massive body in space radiation fields.
- Verify the detailed thermal design of the entire stack assembly.

The ECT hardware is a space-qualified version of hardware developed by the University of Alabama-Huntsville, the Marshall Space Flight Center, Huntsville, and other collaborators over a 15-year period of balloon-flight testing. The space version weighs 550 pounds and is 30 inches on each side and 12 inches high. Jimmie Johnson, Marshall Payload Project Office, is the ECT Experiment Manager and J. Gregory is the Marshall Principal Investigator.

Cryogenic Two Phase

The Cryogenic Two Phase (CRYOTP) experiment is investigating the use of very cold liquids - cryogenics - for the purpose of heat dissipation. Heat pipes are being tested as possible solutions to thermal control problems. The heat pipe is a very efficient heat transfer device commonly used for cooling electronic components and sensors. A heat pipe is essentially a closed, evacuated tube that contains a porous structure, called a wick, and a small quantity of liquid, called the working fluid.

Heat is absorbed at one end of the heat pipe, evaporating liquid contained in the wick structure and forming vapor. This vapor is transported to the other end of the heat pipe, where the heat is released as the vapor condenses. The condensate is transported back to the heated end of the heat pipe by capillary forces formed in the wick, and the cycle is then repeated.

Phase change material storage units also are being investigated as solutions to thermal control of instruments. A phase change material storage unit consists of a container housing a substance that can be frozen using a cryogenic system. Once frozen, the phase change material acts like an ice cube, drawing heat away from instruments or electronics. Once the material has been frozen, the cryo-cooling device can be shut off, thereby eliminating any possible vibration from the cooling unit.

The Brilliant Eyes Thermal Storage Unit (BETSU) is the CRYOTP experiment that will study this type of cryogenic heat dissipation. The BETSU is attached to a heater assembly on one side and to two cryo-coolers on the other side. The BETSU phase change material will absorb thermal energy from the heater in cycles without the internal fluid circulation required by heat pipes.

Very little is known about how heat pipes and the phase change material thermal storage units will perform in orbiting microgravity conditions and which of the possible configurations are better than others.

The CRYOTP experiment is the second flight of a cryogenic test bed developed for the Cryogenic Heat Pipe experiment, which was flown on the STS-53 mission in December 1992. The new test bed configuration replaces a Hughes Aircraft oxygen heat pipe with the BETSU unit on the 2-cooler side of the test bed. The nitrogen Space Heat Pipe is located on the 3-cooler side of the test bed, replacing a TRW oxygen heat pipe.

The BETSU uses approximately 35 grams of 2-methyl-pentane with three percent acetone to provide 2500 joules of stored energy at a melt temperature of 120 degrees Kelvin. The methyl-pentane phase-change material is contained within an aluminum canister. The remainder of the hardware is identical to that flown on the STS-53 mission.

BETSU experiment protocol calls for turning on its two coolers and cooling the phase-change material down to below 120 degrees Kelvin. Once it is determined that the phase-change material is frozen, an electrical heater is activated to melt the material. The BETSU tests consist of melting and freezing the phase-change material at different heating and cooling rates and measuring the temperature stability afforded by melting the material. Melt and freeze cycles are repeated on the BETSU to obtain both demonstrated repeatability and multiple data points for good correlation of existing analytical models.

The Space Heat Pipe uses three coolers and a fibrous wick nitrogen heat pipe fabricated out of titanium alloy. The SHP experiment protocol calls for cycling the coolers for about 6 hours until the temperature is down to 80 degrees Kelvin and stabilizing the temperature with the use of a cooler-mounted heater to compensate for excess cooler capacity.

A heater located on the cooler's evaporator is then activated in one-half watt increments until the heat pipe "dries out," as evidenced through temperature data sent to the ground. The test of the heat pipe transport mechanism is repeated at different temperatures between 70 and 115 degrees Kelvin to obtain multiple data points for corroboration of existing analytical models.

The mission experiment sequence calls for three complete cycles of the two cooler systems for a total of 96 hours of combined experiment time. Flight test results of the CRYOTP experiment will be compared to ground test data and analytical models.

The specific mission objectives for this experiment are:

- Determine the freeze/thaw and temperature control characteristics of the BETSU in a microgravity environment.
- Verify the analytical model for the BETSU's freeze/thaw behavior.
- Provide correlation of flight and ground data for a cryogenic phase-change material.
- Develop confidence, through a space demonstration, for a phase-change material thermal storage unit based on the Brilliant Eyes Ballistic Missile Defense Organization (BMDO) program.
- Determine the transport capability of the Space Heat Pipe (SHP) nitrogen heat pipe in microgravity.
- Verify the analytical model for the SHP performance and establish the correlation between 1-g and microgravity thermal performance.
- Demonstrate SHP start-up from a super-critical condition.
- Establish the cost-effectiveness of a reusable test bed for cryogenic thermal control devices.

Minimum mission success consists of obtaining one complete thermal cycle from each of the two different systems.

The experiment is a joint program of NASA-Goddard and the U.S. Air Force Phillips Laboratory. Ted Swanson, Goddard Engineering Directorate, Thermal Engineering Branch, is the CRYOTP Experiment Manager. Marco Stoyanof, Phillips Laboratory, and Mel Bello, Aerospace Corp., are co-investigators for the BETSU components. Matt Buchko, also Goddard Thermal Engineering Branch, is the Principal Investigator for the SHP.

SHUTTLE SOLAR BACKSCATTER ULTRAVIOLET (SSBUV) INSTRUMENT

Principal Investigator: Ernest Hilsenrath, NASA Goddard Space Flight Center, Greenbelt, Md.

STS-62 is the sixth Space Shuttle flight of the Shuttle Solar Backscatter Ultraviolet (SSBUV) Instrument, a highly calibrated instrument that can be used to check data from ozone-measuring instruments on free-flying satellites. Data from SSBUV, developed at NASA's Goddard Space Flight Center, Greenbelt, Md., are compared to observations from instruments on NASA's Total Ozone Mapping Spectrometer (TOMS) and Upper Atmosphere Research Satellite (UARS), and the National Oceanic and Atmospheric Administration NOAA-9 and NOAA-11 satellites. Calibration of these data sets ensures the most accurate readings possible for the detection of atmospheric ozone trends.

SSBUV and the NOAA SBUV instruments estimate the amount and height distribution of ozone in the upper atmosphere by measuring incoming solar ultraviolet radiation and ultraviolet radiation reflected or scattered back from the Earth's atmosphere. Because ozone absorbs ultraviolet energy, the difference in these measurements can be used to derive ozone levels in the atmosphere.

The SSBUV uses the Space Shuttle's orbital flight path to assess performance by directly comparing data from identical instruments aboard the NOAA spacecraft as the Shuttle and the satellites pass over the same Earth location within an hour. These orbital coincidences can occur 17 times a day.

SSBUV's value lies in its ability to provide precisely calibrated or verified ozone measurements. The instrument is verified to a laboratory standard before flight, then is recalibrated during and after flight to ensure its accuracy. These laboratory standards are routinely calibrated at the National Institute of Standards and Technology, Gaithersburg, Md. This rigorous calibration provides a highly reliable standard to which data from the SSBUV instruments can be compared.

Results from Previous Flights

The five previous SSBUV flights occurred on STS-34 in October 1989, STS-41 in October 1990, STS-43 in August 1991, STS-45/ATLAS-1 in March 1992 and STS-56/ATLAS-2 in April 1993. NASA's goal is to fly SSBUV periodically throughout the 1990s as a vital part of NASA's Mission to Planet Earth, a long-term effort to study Earth as a global environmental system.

Using data from the first three flights, SSBUV has achieved one of its primary objectives: updating the calibration of the NOAA-11 Solar Backscatter Ultraviolet (SBUV/2) ozone sounder, which has been in orbit since late 1988. NOAA data from 1989 to 1993 have been reprocessed, based on SSBUV and the SBUV/2 inflight calibration data provided by NASA.

The reprocessed data have been checked against ground-based ozone observations, and these comparisons show very good agreement. Also, there now is excellent consistency between the refined NOAA-11 data and the Nimbus-7 SBUV/TOMS data set, which goes back to 1978. The combined 15-year data set is a primary resource for ozone, climate and trend studies.

Work is underway to explore how SSBUV data can provide improved ozone observations from the TOMS instrument flying on the Russian Meteor satellite and the upcoming TOMS/Earth Probe scheduled for launch in May 1994.

The fourth and fifth SSBUV flights continued to provide calibration data for the NOAA SBUV/2 and the NASA TOMS instruments and also measured ozone changes from 1992 to 1993. The SSBUV data confirmed TOMS data showing approximately 10 percent ozone depletion in the Northern hemisphere mid-latitudes. Scientists believe that this significant depletion resulted from the combined effects of residual aerosols -- liquid particles -- in the upper atmosphere after the eruption of Mount Pinatubo and cold stratospheric temperatures during the winter of 1992-1993.

Simultaneous measurements by SSBUV with the UARS instruments provide a unique opportunity to tie in the detailed observations of the physics and chemistry of the stratosphere being made by UARS with the regular ongoing NOAA ozone observations. These data sets then can be used as a baseline for detecting long-term changes in the stratosphere.

Operation

The SSBUV instrument and its flight support electronics, power, data and command systems are mounted in the Space Shuttle's payload bay in two flight canisters. The instrument canister holds the SSBUV instrument, its aspect sensors and inflight calibration system.

Once in orbit, a motorized door assembly opens the canister allowing the SSBUV to view the sun and Earth. The canister closes to protect SSBUV from contamination while it performs inflight calibrations.

The support canister contains the avionics including the power, data and command systems. SSBUV obtains power from the Space Shuttle and receives real-time ground commands.

SSBUV is managed by Goddard for NASA's Office of Mission to Planet Earth, Washington, D.C. Mission to Planet Earth is studying how Earth's global environment is changing.

Using the unique perspective available from space, NASA is observing, monitoring and assessing large-scale environmental processes, focussing on climate change. MTPE satellite data, complemented by aircraft and ground data, are allowing scientists to better understand environmental changes and to distinguish human-induced changes from other natural changes. MTPE data, which NASA is distributing to researchers worldwide, are essential to humans making informed decisions about protecting their environment.

DEXTEROUS END EFFECTOR

Powerful electromagnets, generating an attraction force of 3,200 pounds, will be used to grapple objects with the robot arm in Columbia's payload bay during a flight demonstration of the Dexterous End Effector (DEE).

The new end effector and grapple fixture design will increase the arm's dexterity and alignment accuracy, provide operators with a sense of touch and allow the use of more compact "handles" on satellites and payloads.

During the test, three STS-62 crew members will take turns operating and observing the remote manipulator system (RMS) in a series of 1-hour sessions, each involving approximately eight tasks, for a total of about 24 hours. The tasks will involve aligning the arm with targets, grappling a test probe, inserting the test probe into receptacles of progressively smaller clearances and applying force and torque to the probe with the arm.

Extensive testing on the ground has verified the concepts used by DEE, but only in space can the tests reflect the lack of gravity, atmosphere and the extreme temperature shifts to which telerobotic machinery are exposed.

DEE incorporates a magnetic end effector (MEE), a targeting and reflective alignment concept (TRAC) camera system and a carrier latch assembly (CLA), all developed at NASA's Johnson Space Center, and a force torque sensor (FTS) developed by NASA's Jet Propulsion Laboratory. The standard arm configuration is virtually unchanged for this flight.

Magnetic End Effector

MEE uses two U-shaped electromagnets to grab and release payloads fitted with a flat, ferrous grapple fixture or "handle." MEE provides a reliable method of maintaining a good grip on the payload and a safer, more reliable method for releasing it in the event of an RMS or orbiter failure.

If a failure occurs when the arm is mechanically attached to a payload, the ability of the crew to close the payload bay doors and return to Earth could be threatened. MEE eliminates that risk because the electromagnetic grapple always can be terminated by cutting power or allowing the backup batteries to run down. MEE also is smaller, lighter and has fewer moving parts than the standard end effector.

The flat grapple fixture is lighter and more compact than the standard 10-inch-long grapple fixture post. Many proposed space operations for the Shuttle's arm or a space station arm involve stacking and unstacking objects for construction purposes, and grapple posts would reduce the number of components that could be carried in the cargo bay.

Targeting and Reflective Alignment Concept

TRAC provides a simpler, faster, more intuitive grapple alignment targeting system and can be used manually or automatically. It allows for the precise alignment of two objects using a video system and a mirrored target. In essence, the operator looks through a camera that points outward from the center of DEE at the target until the camera can see its own reflection, then finishes the process by lining up a set of cross hairs.

TRAC utilizes one of three additional television cameras at a time. The first is set on the arm's centerline, the second looks out at a right angle from the centerline and the third is mounted separately in the payload bay. Both the camera inside DEE and a monitor on the Shuttle's aft flight deck have alignment marks that are matched to the cross hairs on the reflective target. Once alignment is achieved, the operator drives the arm forward until magnetic forces mate the end effector to the target.

An AUTO-TRAC system designed to enhance the standard TRAC alignment system will use the third camera, a set of flashing light-emitting diodes and a specially equipped payload general support computer to process the television image and provide digital read-outs of the alignment errors for the arm operator.

By comparison, the standard arm configuration includes a camera mounted on top of the end effector and therefore, off-center. The operator must align the arm with a target mounted above the grapple fixture, then engage the end effector's snare-like wires around the grapple fixture. The visual cues of the standard target are black and white markings on a three-dimensional protruding post.

Force Torque Sensor

The FTS provides the robot arm operator with feedback on the forces being applied by the arm and minimizes the loads placed on the RMS. The feedback information is displayed graphically for easy interpretation by the arm operator. The FTS is comprised of a data collection assembly (DCA) that includes a strain gauge and temperature sensors and a display electronics assembly (DEA) that gives the operator insight into how much force and torque are being applied.

Magnetic Attachment Tool

A special adapter will connect the arm's special purpose end effector to an electrical flight grapple fixture on the back of the DEE end effector assembly, which is called the magnetic attachment tool (MAT). Once grappled by the arm operator, MAT becomes the operational end effector for the DEE demonstration test.

Carrier Latch Assembly

Two small payload carriers, called Carrier Latch Assemblies (CLA), will be used during the demonstration. Both use a combination of electromagnetic and mechanical latches. One holds the MAT like a vice during launch and entry, and the other holds the test probe. The CLA's are part of the experiment stowage and activities plate (ESAP) installed on a longeron-mounted getaway special (GAS) beam mounted to the starboard sill of the cargo bay.

Project Management

DEE is managed by the Automation and Robotics Division of NASA's Johnson Space Center, Houston. Project engineers are Leo G. Monford, JSC, and Edward L. Carter, Lockheed Engineering and Sciences Co., Houston. DEE is sponsored by the Office of Space Systems Development, NASA Headquarters, Washington, D.C.

LIMITED DURATION SPACE ENVIRONMENT CANDIDATE MATERIAL EXPOSURE (LDCE)

The Limited Duration Space Candidate Materials Exposure (LDCE) flight series uses small cargo bay payload accommodations to evaluate materials being considered for use in space structures. The LDCE flights are sponsored by the Center on Materials for Space Structures (CMSS), the NASA Center for the Commercial Development of Space at Case Western University, Cleveland. The objective of the CMSS is to provide engineering and scientific services to those involved in developing space systems and structures, with a focus on applying new scientific insights to ground-based applications.

The STS-62 LDCE activities will expose three identical sets of materials to the space environment. Each set is comprised of 264 samples mounted in its own container, the lid of which opens mechanically to expose the samples. The containers are positioned such that when open, the samples face directly up and out of the payload bay. One container will be opened soon after reaching orbit and will be left open until preparations for orbiter reentry.

A second container will be handled the same way except that its lid will be returned to the closed position during mission segments when the cargo bay is facing the direction of orbital motion (the "ram" direction). The third container will be opened only during those times that the cargo bay is facing the ram direction.

Previous LDCE flights had samples mounted only in a "flat" position on a plate perpendicular to the direction of the opening of the container. On STS-62, some samples will be similarly mounted, but others will be centrally mounted in a three dimensional "crown" arrangement to seek exposure to environmental factors coming from all directions above the plane of the sample mounting plate.

PROTEIN CRYSTAL GROWTH (PCG) EXPERIMENTS

Proteins are vital to all life, playing roles from providing nourishment to fighting disease. Since 1985, Protein Crystal Growth (PCG) experiments aboard the Space Shuttle have been helping scientists determine the complex molecular structures of important proteins. The PCG experiment hardware for STS-62 incorporates several improvements based on experience from past Shuttle flights.

By knowing the structure of specific proteins, scientists can design new drug treatments for humans and animals and develop new or better food crops. For example, most pharmaceuticals are formulated by trial and error. But if scientists can identify the precise structure of a disease-related protein, they can use it to design a drug to fit the protein like a key fits a lock.

Researchers use a method called x-ray crystallography to determine the three-dimensional structure of proteins, but analysis requires large, single protein crystals about the size of a grain of table salt. Earth-grown crystals large enough to study often have numerous flaws caused by Earth's gravity. Crystals grown in space tend to have more uniform internal structures, allowing much better x-ray studies.

In addition to producing single, well-ordered protein crystals to be analyzed post-flight, the STS-62 experiment will provide insights into the dynamics involved in the growth of protein crystals in microgravity. By studying crystals grown under different conditions, scientists can improve

methods for producing higher quality crystals and large crystals of hard-to-grow proteins on future flights.

Two different experiments on STS-62 will use the vapor diffusion technique to grow protein crystals in space. One of the two techniques is the improved version of the vapor diffusion apparatus used on previous flights. The other is a flight test of off-the-shelf crystallization chambers commonly used in Earth-based labs.

Vapor diffusion is begun by mixing a protein solution with a solution containing a precipitating agent, such as a salt, to initiate the process. The mixture forms a small droplet, and water from the droplet then transfers to a surrounding reservoir, which is an absorbent material containing a solution with a salt concentration higher than that of the droplet. The water transfer is caused by the difference between vapor pressures of the droplet and reservoir solutions.

Vapor Diffusion Apparatus (VDA) Experiment

A new thermal enclosure system (TES) used in the place of two mid-deck lockers, will house four vapor diffusion apparatus trays. The enclosure can act either as a refrigerator or an incubator. The temperature can be maintained to an accuracy of one-tenth degree Celsius, and it can be programmed to change over time. For the STS-62 flight, the temperature will be maintained at about 72 degrees Fahrenheit (22 degrees Celsius). Internal temperatures are recorded by a data logger in the thermal enclosure system.

Each of the four vapor diffusion apparatus trays in the TES has 20 protein crystal growth chambers. In each chamber, protein solutions are contained in one barrel and precipitating agent solutions in the other barrel of a small, double-barreled syringe.

About 5 hours after launch, a crew member will use a torque device for each tray to simultaneously retract plugs sealing the 20 syringe tips. He then will use the torque device to mix the solutions in each chamber by moving them in and out of the syringes. After mixing, the droplets will be moved out onto the syringe tips so vapor diffusion can begin. Shortly before the Shuttle returns to Earth, a crew member will deactivate the experiment by drawing the droplets, which by then will contain crystals, back into the syringes.

Some of the vapor diffusion apparatus syringes have been modified for this mission. Instead of being parallel, the barrels are bent toward one another at the syringe tips to ensure thorough mixing. On past flights, some solutions did not mix properly.

For instance, scientists had been unable to grow malic enzyme crystals in space until the 1992 United States Microgravity Laboratory-1 mission, when

VDA experiment Principal Investigator Dr. Lawrence DeLucas served as a payload specialist. He was able to produce high-quality malic enzyme crystals by manually mixing the protein and precipitating agent solutions in the glovebox.

Protein Crystallization Apparatus for Microgravity (PCAM) Experiment

STS-62 will be the first flight of commercially purchased protein crystal growth plates, which will be housed in the hand-held PCAM. Four PCAMs, each containing a 6-inch by 4-inch plastic plate with 24 sample chambers, will be stowed in a middeck locker. Protein and precipitant solutions will be pre-mixed and loaded into small receptacles on the tips of pedestals in the centers of the circular chambers. A camcorder will be used to document the condition of solutions inside the PCAMs.

About 5 hours into Flight Day 2, a crew member will withdraw seals over the pedestal receptacles. This will expose the sample solutions to the open chambers, where donut-shaped absorbent reservoirs, containing more concentrated precipitating agent solutions, surround the pedestals. Crystal growth will continue throughout the mission. Solutions containing crystals will remain on the pedestal receptacles after they are resealed to deactivate the experiment shortly before landing.

If the PCAM equipment performs as expected, multiple units will be flown on future missions, allowing many more samples to be loaded in the same volume now used for vapor diffusion apparatus trays.

Individual plates flown for various co-investigators can be taken directly to their labs after landing. Currently, crystals go to a central lab for removal from the more complex vapor diffusion apparatus trays and for preliminary analysis before they are distributed to sponsoring scientists. Decreased handling and turnaround time would enhance x-ray studies of the fragile crystals.

More than a dozen co-investigators from universities, research institutes and pharmaceutical companies around the world have proposed crystals for flight aboard STS-62. Candidate proteins were selected two to three months before the launch date, but the loaded configuration of flight samples in the VDAs and PCAMs will not be finalized until 2 days prior to liftoff.

These protein crystal growth experiments are sponsored by the Office of Life and Microgravity Sciences and Applications, NASA Headquarters, Washington, D.C., and the experiments and hardware are managed by the Marshall Space Flight Center, Huntsville, Ala. Dr. Dan Carter of Marshall is Principal Investigator for the hand-held PCAM experiments, and Dr. Lawrence DeLucas of the University of Alabama, Birmingham, is Principal Investigator for the Vapor Diffusion Apparatus experiments on STS-62.

COMMERCIAL DEVELOPMENT PROTEIN CRYSTAL GROWTH

The Commercial Protein Crystal Growth (CPCG) payload will be located in the Shuttle middeck and will use the space required for up to two standard middeck lockers. Protein crystal growth activities, sponsored by the Center for Macromolecular Crystallography (CMC), based at the University of Alabama-Birmingham, have focused on understanding and improving techniques for growth of protein crystals in space.

It has been shown that the weightlessness of spaceflight provides an excellent environment for improving the quality of protein crystals, which can be used in medical and scientific research. It is expected that the techniques developed by CMC will become the basis for commercially viable endeavors with significant benefit to the U.S. economy, along with providing dramatic advances in medicine and other scientific activities.

MIDDECK 0-GRAVITY DYNAMICS EXPERIMENT

The Middeck 0-Gravity Dynamics Experiment (MODE) is a reusable Space Shuttle middeck facility designed to study the nonlinear, gravity-dependent behavior of two types of space hardware -- contained fluids and large space structures -- planned for future spacecraft.

MODE is classified as a complex secondary payload and occupies 4 middeck lockers. The experiment requires less than 115 watts to operate.

MODE was first flown on STS-48 (Discovery, September 1991) where two separate fluids and structures experiments were combined into a single mission to take advantage of the commonality in the required electronics. In 18 hours of on-orbit operation, the MODE hardware performed flawlessly and returned more than 600 megabytes of high quality data on the nonlinear behavior of fluids and truss structures in the microgravity environment of the Shuttle middeck.

During the STS-62 mission approximately 40 hours of tests will be conducted on the MODE Structural Test Article (STA). MODE operations are scheduled for Flight Days 3 thru 9.

The MODE mission objectives on Shuttle flight STS-62 are:

- Measure structural vibration modes not recorded during STS-48 due to unpredicted behavior of the test article.
- Expand structural test matrix through use of improved fidelity alpha-joint.
- Complete the MODE in-space test matrix.

- Complete and verify an analytical modeling capability for a reliable prediction of the linear and nonlinear modal characteristics of space structures in a microgravity environment.
- Obtain data on space structures to investigate on-orbit modal identification schemes.
- Obtain force measurements of nominal crew-induced disturbance loads on the Shuttle (MODE/STS-62 auxiliary experiment objective)

MODE/STS-62 will perform an extensive array of tests on various configurations of the MODE Structural Test Article (STA) to expand on the structural dynamics results of the STS-48 mission.

The STA is composed of erectable and deployable modules which are arranged to produce configurations. Each module was fashioned after a typical space structural form.

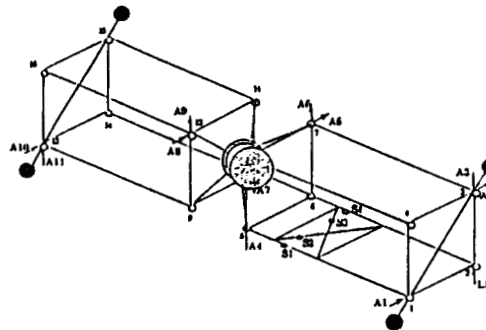
The simplest arrangement of the modules, the "baseline-configuration", is formed from two four-bay deployable modules connected in the center with erectable hardware components to form a straight truss. The objectives of the tests of this configuration are to determine the impact of gravity and suspension influences on a straight truss primarily composed of deployable hardware and to examine the influence of preload in the diagonal bracing wires of the deployable hardware on the measured ground and orbital modal parameters.

A slightly more complicated arrangement of modules, the "alpha-configuration", is formed by replacing the erectable hardware of the center bay in the baseline-configuration with a rotary joint modeled after the alpha joint of the international space station. Although this configuration still forms a straight truss, the additional mass and internal dynamics of the articulating joint substantially changes the behavior of the system. The purpose of testing this configuration is to evaluate the influence of 1-g test methods on a truss with a rotary joint.

A more complex configuration includes deployable modules, erectable hardware and the rotary joint to form a planar truss designated as the "L-configuration". Due to its shape and mass distribution, the L-configuration is the most difficult to test in a 1-g field and provides the greatest challenge to the testing of a planar structure.

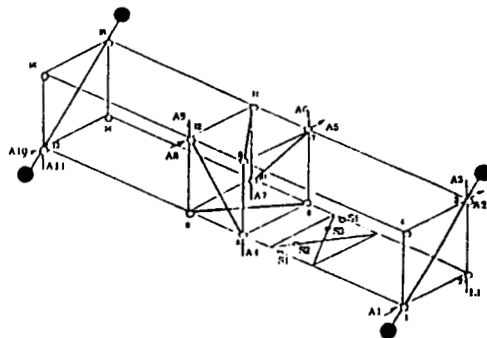
Two sets of test protocols will be conducted on both the alpha- and L-configurations with two different rotary joints. One rotary joint, previously flown on STS-48, is constructed around two aluminum disks whose rotation relative to each other on stainless steel ball bearings can be constrained by a variable frictional load.

- Alpha-Configuration

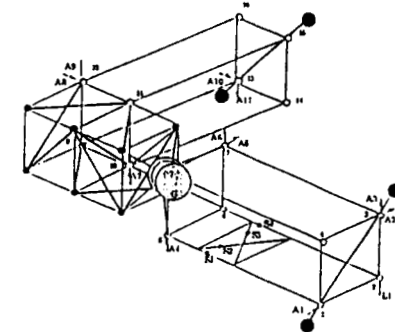


- Utilizes:
 - Adjustable Deployable Unit (No. 1)
 - Non-Adjustable Deployable Unit (No. 2)
 - Alpha Joint
 - 2 Sets of End Masses

- Baseline-Configuration



- Utilizes:
 - Adjustable Deployable Unit (No. 1)
 - Non-Adjustable Deployable Unit (No. 2)
 - 4 Longerons
 - 4 Dingtonals
 - 2 Sets of End Masses



- Utilizes:
 - Adjustable Deployable Unit (No. 1)
 - Non-Adjustable Deployable Unit (No. 2)
 - Alpha Joint
 - Alpha Joint Interface Bay
 - 10 Longerons
 - 9 Diagonals
 - 2 Sets of End Masses

- L-Configuration

- STA Test Configurations

The second rotary joint duplicates the structural load transfer path of the proposed international space station alpha joint and uses a set of torsional rods to more accurately simulate the gear/motor drive train of the space station joint.

Once on-orbit, astronauts will activate the MODE Experiment Support Module (ESM) -- basically, a miniature dynamics laboratory compressed to fit within a middeck locker -- deploy the Structural Test Article (STA) and attach the STA to the ESM via a flexible umbilical cable. The ESM computer then will be commanded to perform one of a series of preprogrammed test protocols.

An astronaut will monitor the experiment and record its operation on videotape. In case of any anomalies, the astronaut can halt the experiment and modify the preprogrammed protocols using a panel-mounted numeric keypad.

MODE Auxiliary Experiment - Crew Motion Force Measurements

This activity is directed to the measurement of crew push-off loads on board the Shuttle and to use these measurements to project the impact of crew motion on the microgravity environment of a space station. The MODE Experiment Support Module will be used to measure the output from a set of three dynamic load sensor assemblies. The three assemblies are configured as:

- Hand-hold (Handle, Spacelab Configuration) -- 6 degrees of freedom measuring forces and moments in three axes
- Foot Restraint (SSP temporary/mission specific configuration) -- 6 degrees of freedom measuring forces and moments in three axes
- Touch pad -- 3 degrees of freedom measuring forces in three axes

Approximately 25 hours of crew motion measurements will be made on Flight Days 7 through 13.

EXTENDED DURATION ORBITER (EDO) MEDICAL PROJECT

A series of detailed supplementary objectives (DSOs) during the STS-62 mission will provide additional information for ongoing medical studies supporting the Extended Duration Orbiter (EDO) Medical Project.

The EDO Medical Project is designed to assess the impact of long-duration spaceflight, 10 or more days, on astronaut health; identify any operational medical concerns and test countermeasures for the adverse effects of weightlessness on human physiology.

For the STS-62 mission, the Medical Sciences Division of the Johnson Space Center, Houston, is sponsoring 11 DSOs that support the project. All of the studies have been flown on previous Shuttle missions.

Four of these tests will take place inflight -- DSO 603B "Orthostatic Function During Entry, Landing and Egress"; DSO 611 "Air Monitoring Instrument Evaluation and Atmosphere Characterization"; DSO 612 "Energy Utilization"; and DSO 623 "Lower Body Negative Pressure (LBNP) Countermeasures". The other DSOs will occur before and/or after the mission.

DSO 603B documents the relationship between mission duration and changes in orthostatic function of crew members during the actual stresses of landing and egress from the seat and crew cabin. The protocol requires crew members to instrument themselves with Holter monitors prior to donning their launch and entry suits. Data from the monitors and blood pressure monitors will be recorded as will comments from the crew members during the operations.

The LBNP activity employs a bag in which a partial vacuum can be created around the lower torso. The bag encases the lower body and seals at the waist. By lowering the pressure within the bag, the subject's body fluids are drawn to his lower extremities, imitating the natural fluid distribution that occurs on Earth due to gravity.

This conditions the cardiovascular system for the fluid shift that occurs upon re-entry and improves orthostatic tolerances. Two types of sessions will be performed with the LBNP during the mission -- 45-minute long "ramp" sessions that imitate the sudden return to gravity and 4-hour long "soak" protocols that attempt to better prepare the subject for the return to gravity.

DSO 611 is designed to evaluate and verify equipment for sampling the microbial contaminant level of the orbiter air. This is done several times during the mission using a device that resembles a large flashlight.

DSO 612 will assist researchers in determining the actual caloric requirements for spaceflight. Crew members will collect urine and saliva samples as well as keep a log of all fluid and food intake. Measurements also will be taken on astronauts' blood glucose levels.

The DSOs performed before and after flight only include: DSO 604 "Visual-Vestibular Integration as a Function of Adaptation"; DSO 605 "Postural Equilibrium Control During Landing/Egress"; DSO 614 "The Effect of Prolonged Space Flight on Head and Gaze Stability During Locomotion" and DSO 626 "Cardiovascular and Cerebrovascular Response to Standing Before and After Space Flight."

DSO 604 studies the changes in the sense of balance and the function of vision as a crew member readapts to gravity by having the subject make specific head movements while looking at a visual target on a locker in front of his seat and recording his sensations on a tape recorder.

DSO 605 is a series of movement coordination tests and sensory organization tests which the subject will perform just after landing. For the test, sensors are placed on one leg to record information on the subject's muscle activity and its readaptation to gravity.

DSO 614 studies the changes in the sense of balance as the subject readapts to gravity and motion in gravity. For the tests, the subject will walk at different speeds on a treadmill after landing and step off of a small step as he looks at various visual targets. Sensors on the legs will record muscle activity during the tests.

DSO 626 measures the subject's integrated cardiovascular responses as they stand up after landing. This test includes the measurement of blood volume.

Other DSOs will be performed largely before and/or after flight, but have a small amount of activity for the subject during flight. These include DSO 608 "Effects of Space Flight on Aerobic and Anaerobic Metabolism During Exercise."

DSO 608 studies the changes in body composition caused by adapting to weightlessness, such as the shift of fluids headward and a general reduction in the total amount of body fluids, and their effect upon a subject's readaptation to gravity. The only activity required in flight is for the crew member to record their daily fluid intake. After the flight, oxygen intake and body hydration are measured during a series of treadmill sessions, and total lean body mass is determined.

DSO 610 "In-Flight Assessment of Renal Stone Risk" is a study to determine whether prolonged exposure to weightlessness increases the risk of developing renal stones, commonly called kidney stones. For the assessment, subjects maintain a log of their food intake, fluid intake and exercise during the flight and take urine samples at periodic times.

BIOREACTOR DEMONSTRATION SYSTEM: BIOTECHNOLOGY SPECIMEN TEMPERATURE CONTROLLER

The Biotechnology Specimen Temperature Controller (BSTC) experiment on STS-62 is the first phase of a series of four development tests that will fly on upcoming Shuttle missions to assist in development of the Bioreactor, a cell-culture growth device under development at the Johnson Space Center. The BSTC will test the performance of a temperature control device being developed for use with the Bioreactor. Proper control of temperature is a critical element of cell culture growth.

The BSTC experiment does not include a prototype Bioreactor onboard. It is a test of a heating device that may be used with the Bioreactor and the experiment takes one middeck locker onboard Columbia. Colon carcinoma cells completely sealed in cell-culture chambers will be loaded into the unit prior to launch. The only crew interaction required is to turn the temperature controller on the outside of the experiment to 35 degrees Centigrade after reaching orbit. Following landing, the cell cultures will be removed by ground personnel and the specimens studied to evaluate the operation of the temperature controller.

A ground-control group of the same type cells and the same equipment will be run concurrently with the onboard device.

PHYSIOLOGICAL SYSTEM EXPERIMENT (PSE)

The Center for Cell Research, a NASA Center for the Commercial Development of Space at Pennsylvania State University, is sponsoring its fourth Physiological Systems Experiment payload on this flight. This class of experiments includes those which are designed to evaluate pharmaceutical, agricultural or biotechnological products.

The primary objective of PSE-04 is to study the complex interrelationship between the immune and skeletal systems during exposure to microgravity. Previous NASA and Center for Cell Research flight experiments have demonstrated that microgravity exposure rapidly impairs musculo-skeletal and immune system functions simultaneously.

The simultaneous impairment of these two systems also occurs in some disease states on Earth and indicates that the physiological controls of the two systems may be linked. To test the linkage hypothesis, a pharmaceutical that has the capacity to modulate both bone and immune cell function will be administered to 12 adult female rats prior to spaceflight.

COMMERCIAL GENERIC BIOPROCESSING APPARATUS

This payload is sponsored by the NASA Center for the Commercial Development of Space at the University of Colorado-Boulder, BioServe Space Technologies. The payload supports more than 15 commercial life science investigations that have application in biomaterials, biotechnology, medicine and agriculture. Investigations have been selected on the basis of commercial potential and ability to take advantage of the extended orbit time on this flight.

Each experiment sample is contained in a custom designed test tube called the Fluids Processing Apparatus (FPA). Each FPA typically contains three separate fluids that can be mixed sequentially on orbit by depressing a plunger mechanism. Generally the first two fluids are mixed early in the mission.

After a predefined processing interval, the third fluid is added to preserve the sample materials for return to Earth for detailed analysis. A wide variety of commercial life sciences investigations can be performed using this simple, generic approach.

AIR FORCE MAUI OPTICAL SYSTEM

The Air Force Maui Optical System (AMOS) is an electrical-optical facility on the Hawaiian island of Maui. No hardware is required aboard Columbia to support the experimental observations. The AMOS facility tracks the orbiter as it flies over the area and records signatures from thruster firings, water dumps or the phenomena of "Shuttle glow," a well-documented fluorescent effect created as the Shuttle interacts with atomic oxygen in Earth orbit. The information obtained by AMOS is used to calibrate the infrared and optical sensors at the facility.

STS-62 CREW BIOGRAPHIES

John H. Casper, 50, Col., USAF, will be Commander (CDR) of STS-62. Casper considers Gainesville, Ga., his hometown. He will be making his third space flight.

Casper graduated from Chamblee High School, Chamblee, Ga., in 1961; received a bachelor's in engineering science from the Air Force Academy in 1966; received a master's in astronautics from Purdue University in 1967; and graduated from the Air Force War College in 1986.

Casper was a fighter pilot in the F-100 and F-4 aircraft and flew 229 combat missions in Vietnam. As a test pilot at the Air Force Flight Test Center, Casper was Chief, F-4E Test Team, and later commanded the 6513th Test Squadron. Assigned to Air Force Headquarters, he served as Deputy Chief of Special Projects for the Deputy Chief of Staff, Plans and Operations.

Casper became an astronaut in 1984. He was lead astronaut for improving the Shuttle orbiter nosewheel steering, brakes, tires and development of the landing drag chute. He also was an ascent/entry capsule communicator (CapCom) in the Mission Control Center. In 1990, Casper was Pilot for STS-36, a dedicated Department of Defense mission. In 1993, he commanded STS-54, which deployed a Tracking and Data Relay Satellite.

Casper has flown nearly 7,000 hours in 50 different aircraft and has logged 250 hours in space.

Andrew M. Allen, 38, Major, USMC, will be Pilot (PLT) of STS-62. Selected as an astronaut in 1987, Allen was born in Philadelphia, Pa., and will be making his second space flight.

Allen graduated from Archbishop Wood High School, Warminster, Pa., in 1973 and received a bachelor's in mechanical engineering from Villanova University in 1977.

Allen was commissioned in the Marine Corps in 1977 and following flight school, flew F-4 Phantoms from 1980-83 at the Marine Corps Air Station, Beaufort, S.C. He was later selected for fleet introduction of the F/A-18 Hornet and flew that aircraft at the Marine Corps Air Station in El Toro, Calif., from 1983-86. During his assignment in El Toro, Allen graduated from the Marine Weapons and Tactics Instructor Course and the Naval Fighter Weapons School (Top Gun). In 1987, he graduated from the Navy Test Pilot School and was a test pilot under instruction when selected by NASA.

Allen's first Shuttle flight was as Pilot of STS-46, a mission that carried the Tethered Satellite System aboard Atlantis in August 1992. Allen has logged more than 191 hours in space and 4,000 flying hours in 30 different type of aircraft.

Pierre J. Thuot, 38, Cmdr., USN, will be Mission Specialist 1 (MS1). Selected as an astronaut in 1985, Thuot considers Fairfax, Va., and New Bedford, Mass., to be his hometowns. He will be making his third space flight.

Thuot graduated from Fairfax High School, Fairfax, Va., in 1973; received a bachelor's in physics from the U.S. Naval Academy in 1977; and received a master's in systems management from the University of Southern California in 1985.

Thuot received his wings with the Navy in 1978 and trained as a radar intercept officer in the F-14 Tomcat. He later made overseas deployments aboard the USS John F. Kennedy and the USS Independence to the Mediterranean and Caribbean and attended the Navy Fighter Weapons School (Top Gun). He graduated from the Naval Test Pilot School in 1983 and was an instructor at that school at the time of his selection by NASA.

Thuot's first Shuttle flight was as a mission specialist on STS-36, a Department of Defense mission aboard Atlantis in February 1990. He next flew as a mission specialist on the first flight of Endeavour on STS-49 in May 1992, a mission that repaired the stranded Intelsat VI F3 communications satellite. During that mission, Thuot performed three spacewalks to capture and repair the satellite.

Thuot has logged more than 319 hours in space, including almost 18 hours spacewalking, and more than 3,000 flying hours in more than 40 different aircraft.

Charles D. (Sam) Gemar, 38, Lt. Col., USA, will be Mission Specialist 2 (MS2). Selected as an astronaut in 1985, Gemar considers Scotland, S.D., his hometown. He will be making his third space flight.

Gemar graduated from Scotland Public High School in 1973 and received a bachelor's in engineering from the U.S. Military Academy in 1979.

Gemar enlisted in the Army in 1973 and after graduating from West Point, attended the Infantry Officers Training Course, Initial Entry Rotary Wing Aviation Course and the Fixed Multi-Wing Aviator's Course at Ft. Rucker, Ala. In 1980, he began assignment at Stewart/Hunter Army Airfield as an assistant flight operations officer and flight platoon leader. He also completed the Army Parachutist Course, Ranger School and the Aviation Officers Advanced Course.

Gemar's first Shuttle flight was as a mission specialist on STS-38, a Department of Defense mission aboard Atlantis in November 1990. He next flew as a mission specialist on STS-48 aboard Discovery that deployed the Upper Atmosphere Research Satellite in September 1991. Gemar has logged more than 245 hours in space.

Marsha S. Ivins, 42, will be Mission Specialist 3 (MS3). She was selected as an astronaut in 1984. Ivins considers Wallingford, Pa., to be her hometown. She will be making her third space flight.

Ivins graduated from Nether Providence High School in Wallingford in 1969 and received a bachelor's in aerospace engineering from the University of Colorado in 1973.

Ivins joined NASA in 1974 as an engineer in the Crew Station Design Branch at the Johnson Space Center, working on orbiter displays and controls and man-machine engineering. Among her major tasks was participating in development of the orbiter's heads-up display. In 1980, she was assigned as a flight simulation engineer on the Shuttle Training Aircraft.

Ivins holds a multi-engine Airline Transport Pilot License, single-engine, airplane, land, sea and glider commercial licenses, and airplane, instrument and glider flight instructor ratings.

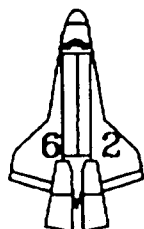
Her first Shuttle flight was as a mission specialist on STS-32 aboard Columbia that retrieved the Long Duration Exposure Facility in January 1990. She next flew as a mission specialist on STS-46 which carried the Tethered Satellite System aboard Atlantis in August 1992. Ivins has logged more than 452 hours in space and more than 5,000 flying hours in civilian and NASA aircraft.

SHUTTLE FLIGHTS AS OF FEBRUARY 1994

60 TOTAL FLIGHTS OF THE SHUTTLE SYSTEM -- 35 SINCE RETURN TO FLIGHT

			STS-60 Launched 2/3/94	
			STS-51 09/12/93 - 09/22/93	
			STS-56 04/08/93 - 04/17/93	
		STS-58 10/18/93 - 11/01/93	STS-53 12/2/92 - 12/9/92	
		STS-55 04/26/93 - 05/06/93	STS-42 01/22/92 - 01/30/92	
		STS-52 10/22/92 - 11/1/92	STS-48 09/12/91 - 09/18/91	
		STS-50 06/25/92 - 07/09/92	STS-39 04/28/91 - 05/06/91	STS-46 7/31/92 - 8/8/92
		STS-40 06/05/91 - 06/14/91	STS-41 10/06/90 - 10/10/90	STS-45 03/24/92 - 04/02/92
		STS-35 12/02/90 - 12/10/90	STS-31 04/24/90 - 04/29/90	STS-44 11/24/91 - 12/01/91
		STS-32 01/09/90 - 01/20/90	STS-33 11/22/89 - 11/27/89	STS-43 08/02/91 - 08/11/91
		STS-28 08/08/89 - 08/13/89	STS-29 03/13/89 - 03/18/89	STS-37 04/05/91 - 04/11/91
		STS 61-C 01/12/86 - 01/18/86	STS-26 09/29/88 - 10/03/88	STS-38 11/15/90 - 11/20/90
		STS-9 11/28/83 - 12/08/83	STS 51-L 08/27/85 - 09/03/85	STS-36 02/28/90 - 03/04/90
		STS-5 13/11/82 - 11/16/82	51-G 06/17/85 - 06/24/85	STS-34 10/18/89 - 10/23/89
		STS-4 06/27/82 - 07/04/82	51-D 04/12/85 - 04/19/85	STS-30 05/04/89 - 05/08/89
		STS-3 03/22/82 - 03/30/82	STS 51-C 01/24/85 - 01/27/85	STS-27 12/02/88 - 12/06/88
		STS-2 11/12/81 - 11/14/81	STS 51-A 11/08/84 - 11/16/84	STS 61-B 11/26/85 - 12/03/85
		STS-1 04/12/81 - 04/14/81	STS 41-D 08/30/84 - 09/04/84	STS 61-J 10/03/85 - 10/07/85
STS 51-L 01/28/86				
STS 61-A 10/30/85 - 11/06/85				
STS 51-F 07/29/85 - 08/06/85				
STS 51-B 04/29/85 - 05/06/85				
STS 41-D 10/5/84 - 10/13/84				
STS 41-C 04/08/84 - 04/13/84				
STS 41-B 02/03/84 - 02/11/84				
STS-8 08/30/83 - 09/05/83				
STS-7 06/18/83 - 06/24/83				
STS-6 04/04/83 - 04/06/83				
OV-099 Challenger (10 flights)	OV-102 Columbia (15 flights)	OV-103 Discovery (17 flights)	OV-104 Atlantis (12 flights)	OV-105 Endeavour (5 flights)
				STS-61 12/2/93 - 12/13/93
				STS-57 6/21/93 - 7/1/93
				STS-54 01/13/93 - 01/19/93
				STS-47 09/12/92 - 09/20/92
				STS-49 05/07/92 - 05/16/92

Upcoming Space Shuttle Flights

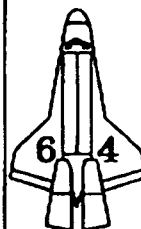


Columbia

1994
Pad 39-B

Launch targeted for March. Extended duration orbiter. Payloads include OAST-2 and USMP-2. 39 degrees/185 st.miles. Fourteen days. Crew: John H. Casper; Andrew M. Allen; Pierre J. Thuot; Charles D. "Sam" Gemar; Marsha S. Ivins.

Landing: KSC

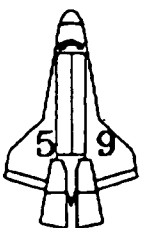


Discovery

1994
Pad 39-B

Launch targeted for September. Payloads include Lidar In-space Technology Experiment(LITE). Inclination 57 degrees/161 st. miles. Nine days. Crew: Richard N. Richards; L. Blaine Hammond Jr.; Carl J. Meade; Mark C. Lee; Susan J. Helms.

Landing: KSC

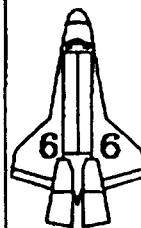


Endeavour

1994
Pad 39-A

Launch targeted for April. Mission includes Space Radar Lab-1. Inclination 57 degrees/138 st. miles. Nine days. Crew includes: Sidney M. Gutierrez; Kevin P. Chilton; Linda M. Godwin (PC); Thomas D. Jones; Jay Apt; Michael R. "Rich" Clifford.

Landing: KSC

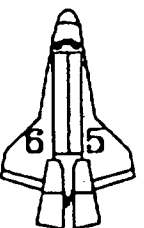


Atlantis

1994
Pad 39-A

Launch targeted for October. Payloads include Atlas-03, CRISTA-SPAS, SSBUV/A-03. Inclination 57 degrees/185 st. miles. Ten days. Crew: Donald R. McMonagle; Curtis L. Brown; Ellen Ochoa (PC); Scott E. Parazynski; Joseph R. Tanner; Jean-Francois Clervoy.

Landing: KSC

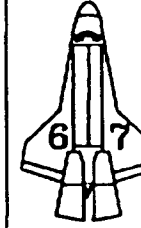


Columbia

1994
Pad 39-A

Launch targeted for July. Primary payload is International Microgravity Laboratory-2. Inclination 28.45 degrees/185 st. miles. 13 days. Robert D. Cabana; James D. Halsell Jr.; Richard J. Hieb; Leroy Chiao; Donald A. Thomas; Carl E. Walz; Chiaki Mukai.

Landing: KSC

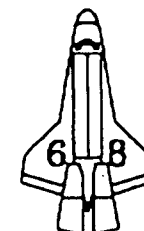


Columbia

1994
Pad 39-B

Launch targeted for December. Payload is ASTRO-02. Inclination 28.5 degrees/218 st. miles. Thirteen days. Crew: Stephen S. Oswald; William G. Gregory; Tamara E. Jernigan (PC); John M. Grunsfeld; Wendy B. Lawrence; Ronald A. Parise; Samuel T. Durrance.

Landing: KSC

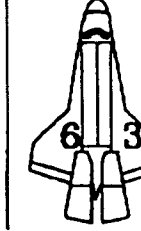


Endeavour

1994
Pad 39-A

Launch targeted for August. Payloads include Space Radar Laboratory-02. Inclination 57 degrees/138 st. miles. Nine days. Crew: Michael A. Baker; Terrence W. Wilcutt; Thomas D. Jones (PC); Steven L. Smith; Peter J. K. Wisoff; Daniel W. Bursch.

Landing: KSC



Discovery

1995
Pad 39-A

Launch targeted for January. Payloads include Spacehab-3, Spartan-201 and Oderacs-02. Inclination 51.6 degrees/195 st. miles. Eight days. Crew: James D. Wetherbee; Kileen M. Collins; C. Michael Foale; Janice E. Voss; Bernard A. Harris Jr.; Vladimir G. Titov. (Mir rendezvous mission).

Landing: KSC

SOME NOTES ON THIS SCHEDULE: This is an unofficial Space Shuttle launch schedule covering the period from March 1994 through January 1995. Crew listings name commanders first, then pilots, then mission and payload specialists. This flight listing is based on the April 1993 Mixed Fleet Manifest. This graph is prepared by the Kennedy Space Center Public Information Office and is dated Feb. 11, 1994. Abbreviations used include: EPD = Earliest Possible Date. TBD = To Be Determined. * = Public Affairs Commentator. Official launch dates are set at Flight Readiness Review.

Posted: Mon, Feb 14, 1994 10:49 AM EST

Msg: PJJE-3135-1090

From: HQNEWSROOM

To: PAOLOOP.NASAMAIL,
(C:USA,ADMD:TELEMAIL,PRMD:GSFC,O:GSFCMAIL,UN:PUBINFO),
(SITE:INTERNET,ID:<PAOLOOP(a)JPL.NASA.GOV>), P,
(C:USA, ADMD:TELEMAIL, PRMD:GSFC, O:GSFCMAIL, UN:PUBINFO)

Subj: N94-16/MEDIA BRIEFING

Brian Dunbar
Headquarters, Washington, D.C.
February 14, 1994
(Phone: 202/358-1547)

NOTE TO EDITORS: N94-16

MEDIA INVITED TO ENVIRONMENTAL RESEARCH MEETING

Dr. Charles F. Kennel, NASA's Associate Administrator for Mission to Planet Earth, will meet with reporters to discuss issues concerning the program and the outlook for 1994, NASA's busiest year for environmental research.

The meeting will be at 3 p.m. EST, Tuesday, Feb. 15, in the Program Review Center, Room 9H40 at NASA Headquarters, 300 E. St. S.W., Washington, D.C. On-camera interviews may be arranged by contacting Brian Dunbar.

-end-

Posted: Mon, Feb 14, 1994 10:53 AM EST

Msg: NJJE-3135-1132

From: PAO.KSC

To: P, PF, PAOLOOP.NASAMAIL,
(C:USA,ADMD:TELEMAIL,PRMD:GSFC,O:GSFCMAIL,UN:PUBINFO),
(SITE:INTERNET,ID:<PAOLOOP(a)JPL.NASA.GOV>),
(C:USA, ADMD:TELEMAIL, PRMD:GSFC, O:GSFCMAIL, UN:JRUFF),
DRYIDENTV,
DARLEEN HUNT (FAX:407 867-3395),
STEVE DUTCZAK (FAX:407 867-7242),
ED HARRISON (FAX:407 867-2097),
GUEST OPERATIONS-VIC (FAX:407 867-4327)

Subj: SPACE RADAR LAB STATUS/NTE

For Release

Mark Hess/Jim Cast
Headquarters, Washington, D.C.
(Phone: 202/358-1779)

February 15, 1994

NOTE TO EDITORS: N94-17

SPACE STATION PRESS OPPORTUNITY SCHEDULED

A press availability with NASA's new Space Station Program Director, Wilbur C. Trafton, will be held on Friday, Feb. 18, between 11:00 and 12:00 a.m. EST. The meeting will be held at NASA Headquarters, 300 E Street, S.W., on the 7th floor, room 7C61 (known as OSF Conference Room #1).

This is the first of what will be regular, informal meetings with the press to discuss the status of the international space station. These sessions will be on the record, but it is requested that there be no television cameras. The meeting will not be carried on NASA Select.

Members of the press wishing to attend should call the contacts listed above, or the NASA Newsroom at 358-1600, by close of business on Thursday, February 17.

- end -



Ed Campion
Headquarters, Washington, D.C.
(Phone: 202/358-1778)

For Release
February 16, 1994

Bruce Buckingham
Kennedy Space Center, Fla.
(Phone: 407/867-2468)

EDITORS NOTE: N94-18

NASA SETS MARCH 3 FOR STS-62 SHUTTLE LAUNCH

NASA managers today set March 3, 1994, as the official launch date for Space Shuttle mission STS-62. The flight will involve Space Shuttle Columbia with a 5 person crew conducting dozens of experiments that run the gamut of space research -- from materials processing to biotechnology, to advanced technology to environmental monitoring.

The launch window on March 3 opens at 8:54 a.m. EST and extends for 2-1/2 hours. The planned mission duration is 13 days, 23 hours and 4 minutes. An on-time launch on March 3 would produce a landing at 7:58 a.m. EST on March 17 at the Kennedy Space Center, Fla.

Leading the five-person STS-62 crew will be Mission Commander John H. Casper who will be making his third spaceflight. Pilot for the mission is Andrew M. Allen who will be making his second space flight. The mission specialists for STS-62 are Pierre J. Thuot, Charles D. (Sam) Gemar and Marsha S. Ivins, all of whom will be making their third space flight.

- end -

Ed Campion
Headquarters, Washington, D.C.
(Phone: 202/358-1778)

For Release
February 18, 1994

NOTE TO EDITORS: N94-19

MISSION BRIEFINGS TO BE HELD FEB. 22-24

Two Space Shuttle crews, one just returned from space, the other preparing for a mission in early March, will meet with the news media in press conferences originating from the Johnson Space Center (JSC), Houston, and various other NASA centers next week.

The mission briefings will begin Feb. 22 with a series of overview sessions on the Space Shuttle Columbia STS-62 flight, which is scheduled for launch from the Kennedy Space Center on March 3. The mission overview by lead Flight Director Phil Engelauf, originating from JSC, from 12 noon to 1 p.m. EST. An overview of the second U.S. Microgravity Payload, will originate from the Marshall Space Flight Center, Huntsville, Ala., from 1 to 2:15 p.m. EST. At 2:30 p.m. EST, a briefing on the Shuttle Solar Backscatter Ultraviolet experiment will originate from the Goddard Space Flight Center (GSFC), Greenbelt, Md. From 3 to 3:30 p.m. EST, the final briefing of the day, on the Middeck Zero-Gravity Dynamics Experiment, will originate from JSC.

On Feb. 23, the STS-62 crew preflight press conference will originate from JSC beginning at 10 a.m. EST. The crew consists of Commander John H. Casper, Pilot Andrew M. Allen and Mission Specialists Pierre J. Thuot, Charles D. "Sam" Gemar and Marsha S. Ivins. At noon EST, a briefing will be held from GSFC on the Office of Aeronautics and Space Technology payload that will fly on STS-62.

On Feb. 24, the crew of STS-60 will meet with the news media at JSC at 10 a.m. EST. Crew Commander Charles F. Bolden, Jr., Pilot Kenneth S. Reightler, Jr., Payload Commander Franklin R. Chang-Diaz, and Mission Specialists N. Jan Davis, Ronald M. Sega and Sergei K. Krikalev of Russia will discuss their recent flight, which landed Feb. 11.

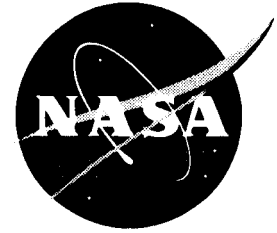
All briefings will be carried live on NASA Select television. NASA Select programming is carried on GTE Spacenet 2, transponder 5. The frequency is 3880 MHz and the orbital position is 69 degrees west longitude.

- end -

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 358-1600



For Release

Don Savage

Headquarters, Washington, D.C.

(Phone: 202/358-1547)

February 17, 1994

EMBARGOED UNTIL FEBRUARY 18, 1994

James H. Wilson

Jet Propulsion Laboratory, Pasadena, Calif.

(Phone: 818/354-5011)

Stephen Lyons

Washington State University, Pullman, Wash.

(Phone: 509/335-5095)

RELEASE: 94-26

COMPUTER MODEL OF NEAR-EARTH ASTEROID SHOWS "DOUBLE OBJECT"

Two NASA-sponsored scientists have produced the first-ever detailed, three-dimensional reconstruction of one of the thousands of asteroids in the solar system whose orbits bring them extremely near to Earth.

Scott Hudson of Washington State University in Pullman, Wash., and collaborator Steven Ostro of NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif., created the computer model of the double-lobed asteroid 4769 Castalia from radar data obtained in 1989 by Ostro and others, using the Arecibo Observatory in Puerto Rico. The asteroid was discovered by Eleanor Helin of JPL at the Palomar Observatory in 1989.

Hudson and Ostro's computer model and the resulting pictures appear in the Feb. 18 issue of Science magazine.

"This computer model of Castalia represents the first detailed, three-dimensional reconstruction of a solar system body from radar data," Hudson said. The effective resolution in this reconstruction is about 330 feet (100 meters).

At about a mile (just under 2 kilometers) across, Castalia is smaller than any solar system object for which spacecraft images have been taken -- including the two asteroids, Gaspra and Ida, recently imaged by NASA's Galileo spacecraft.

- more -

Ostro said that previously it was very difficult to interpret radar images of small, irregularly-shaped bodies. But with the development of this new reconstruction technique, the scientific value of radar observations has been dramatically enhanced.

"I hope that the Castalia model will enhance interest in a program of exploration of these small bodies, including both Earth-based observations and spacecraft missions," he said. "A radar-derived model of a target asteroid would make close maneuvering easier, and the mission easier and cheaper."

Ostro also noted that the Castalia model verifies the suspicion of many astronomers that the near-Earth asteroids would prove to be the most irregularly shaped worlds in the solar system.

"Understanding the origins of those shapes, especially the detailed role of collisions, is an important theoretical challenge," he said. The scientists believe that the double-lobed shape of Castalia shown by the model resulted from a gentle collision between two separate asteroids some time in the past.

Nearly 300 near-Earth asteroids are currently known. It is thought that more than 1,000 as large as Castalia, plus 100 million as large as a house, remain to be discovered. Most of them are thought to have been thrown into the inner solar system from the main asteroid belt, between Mars and Jupiter, by long periods of gravitational interaction with the planets.

With unstable orbits, they eventually might be thrown out of the solar system by the same forces or possibly collide with planets.

The scientists believe that continuing improvements in radar telescopes, expanded optical programs to search for near-Earth asteroids and modeling techniques like this one will provide greatly increased knowledge of the properties and histories of these strange, nearby worlds.

The research was part of the Innovative Research Program, the Planetary Geology and Geophysics Program and the Planetary Astronomy Program of NASA's Office of Space Science, Washington, D.C.

- end -

NOTE TO EDITORS: A photograph of asteroid Castalia is available to media representatives by calling NASA's Broadcast and Imaging Branch on 202/358-1900.

B&W: 94-H-67

Ed Campion
Headquarters, Washington, D.C.
(Phone: 202/358-1778)

For Release

February 23, 1994

Debra Rahn
Headquarters, Washington, D.C.
(Phone: 202/358-1639)

Kyle Herring
Johnson Space Center, Houston
(Phone: 713/483-5111)

RELEASE: 94-27

CAMERON TO MANAGE NASA ACTIVITIES AT STAR CITY, RUSSIA

As part of the new partnership effort between the United States and Russia, NASA today announced that astronaut Kenneth D. Cameron (Col., USMC) has been selected to manage NASA operational activities at Star City and at the Russian control center at Kaliningrad.

As Director of Operations-Russia, Cameron will work with Russian Space Agency engineers and flight controllers on the U.S.-Russian cooperative program and work to bring about continued and enhanced cooperation between NASA and the Russian Space Agency.

Cameron's responsibilities will include supervising NASA astronaut training at Star City, developing training syllabus for Shuttle crew members for Mir rendezvous missions and coordinating training for scientific experimenters; establishing and maintaining operations, operational relationships, plans and procedures to support flight operations between NASA and the Russian Space Agency in joint Shuttle/Mir flights and space station development, assembly and operations.

Cameron is expected to command one of the early Space Shuttle docking missions to the Russian Mir space station.

Cameron and fellow astronauts Norman E. Thagard, M.D., and Bonnie J. Dunbar, Ph.D., who recently were named as the prime and backup crew members for a 3-month flight on the Russian space station Mir, will leave the Johnson Space Center, Houston, for Star City, today.

- more -

Thagard and two cosmonauts will be launched aboard a Russian rocket to Mir in March 1995. Three months later, the crew of mission STS-71 will dock Space Shuttle Atlantis to Mir, the first of up to 10 Shuttle visits that will be made to the Russian space station over the 1995-1997 time frame.

Cameron has flown twice on the Shuttle. He was the Pilot on Atlantis' STS-37 mission in 1991 to deploy the Compton Gamma Ray Observatory. He served as Commander of Discovery's STS-56 flight in 1993 to continue studies of the Earth's atmosphere as part of a series of missions called Atmospheric Laboratory for Applications and Science.

Cameron received a bachelor of science degree in aeronautics and astronautics from the Massachusetts Institute of Technology in 1978 and a master of science degree in the same field from MIT in 1979. Cameron was selected to be an astronaut in 1984. He was born in Cleveland.

-end-

For Release

Dwayne C. Brown
Headquarters, Washington, D.C.
(Phone: 202/358-0547)

February 23, 1994

Paula Korn
Brown University, Providence, R.I.
(Phone: 401/863-2476)

RELEASE: 94-28

NASA INSTALLS TELECONFERENCE SYSTEM FOR GATEWAY TO MOSCOW

NASA's Office of Space Communications has installed a Video Teleconference System (ViTS) facility at Brown University, Providence, R.I., to expand video teleconferencing coverage to Russia. The new facility also enables a connection to NASA's Program Support Communications Network (PSCN), providing video teleconferencing with NASA's field centers, international partners and contractors connected to the network.

The installation connects NASA's PSCN with the university's established satellite circuit link with Russia. For several years, Brown has had video teleconferencing capabilities with the Russian Institute of Space Research (IKI) in Moscow, through direct transmissions on the Russian Intersputnik satellite. The linkage accommodates 2-way discussions between members of the university's planetary geology group and scientists at IKI. This installation will allow NASA's network also to be linked with IKI.

The new ViTS facility will allow NASA scientists and engineers to work directly with researchers to collaborate in real time on their projects. In addition, the connection between teachers, NASA scientists and engineers will provide an unprecedented educational resource for the classroom.

Brown University has a long history of support for NASA, through grants and contracts, by performing planetary geological research and providing access of NASA data from interplanetary spacecraft and probes to scientists and the general public. Brown was an active participant in U.S. and Russian planetary missions, including the U.S. Magellan and Galileo missions and Russia's Venera and Phobos missions.

The United States has signed agreements with the Russian government for cooperation in space exploration and research. The recent February Space Shuttle Discovery flight demonstrated a first step in a three-phased program of U.S./Russian cooperation, with the participation of a Russian cosmonaut serving as a crew member. Phase one entails up to 10 Space Shuttle-Mir missions that include rendezvous, docking and crew transfers to occur between 1995 and 1997. Phase two is the joint development of the core international space station program. Phase three is the expansion of the space station to include all international partners.

The NASA ViTS is a state-of-the-art network that can link any or all of 15 NASA sites with high quality video and audio teleconferencing capabilities. The nationwide network has additional gateways to NASA's international partners, including the European Space Agency, the Japanese Space Agency, the Canadian Space Agency and most recently, the Russian Space Agency.

The Office of Space Communications is responsible for planning, development and operation of worldwide communications, command, navigation and control, data acquisition, telemetry and data processing essential to the success of NASA programs and activities.

Dwayne C. Brown
Headquarters, Washington, D.C.
(Phone: 202/358-0547)

For Release
February 25, 1994

Allen Kenitzer
Goddard Space Flight Center, Greenbelt, Md.
(Phone: 301/286-8955)

RELEASE: C94-h

NASA SELECTS RAYTHEON TO NEGOTIATE \$171 MILLION CONTRACT

NASA has selected Raytheon Service Co., Burlington, Mass., to negotiate a cost-plus-award fee contract to provide logistics support to the Mission Operation and Data Systems Directorate at the Goddard Space Flight Center, Greenbelt, Md. The estimated contract value is \$171 million.

The contract will provide comprehensive logistics support for the program elements of the Office of Space Communications, Washington, D.C. These elements include tracking stations, network and satellite mission control centers, communications networks, flight dynamics and data processing facilities and the engineering activities supporting these operational elements.

The contract is expected to become effective on or about April 1, 1994 and run through March 31, 1999.

-end-

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 358-1600



For Release

Drucella Andersen
Headquarters, Washington, D.C.
(Phone: 202/358-4733)

February 25, 1994

Keith Henry
Langley Research Center, Hampton, Va.
(Phone: 804/864-6120)

RELEASE: 94-29

REPORT CALLS FOR GREATER NASA GENERAL AVIATION ROLE

In a report released today, an industry-led task force calls on NASA to revitalize its general aviation program, make its wind tunnels, laboratories and simulators more accessible to the general aviation community and better balance its technology program to meet general aviation needs.

"This report will help us shape our general aviation research for the rest of the decade," said NASA Administrator Daniel S. Goldin. "We're determined to focus on technologies that will be useful to our partners in industry."

General aviation covers a wide range of aircraft and services as a vital part of the national air transportation system serving some 17,800 airports, provides the only air transportation for millions of people to many communities throughout the United States and the world, provides some 540 thousand U.S. jobs and is a potentially significant contributor to the U.S. balance of trade.

The report by the General Aviation Task Force of NASA's Aeronautics Advisory Committee, citing the serious decline in general aviation aircraft deliveries since the early 1980s, highlights four NASA technology research areas that it characterizes as "most important and potentially the most productive" for increasing market share. They are:

- o Propulsion, noise and emissions work to let U.S. aircraft meet world environmental standards and be more reliable, fuel-efficient and easier to fly;
- o Aeronautical systems research that would put new technology in the cockpit to expand the use of general aviation and increase safety;

- more -

- o Structure and materials development that would transfer data on advanced metals and composites to the general aviation industry; and

- o Aerodynamics research that would increase aircraft speed, passenger capacity and fuel efficiency.

The report also calls for NASA and the Federal Aviation Administration (FAA) to better disseminate research information to the general aviation industry and to develop closer ties among NASA, industry and universities.

NASA already has initiated and expanded its general aviation effort that is developing technology to improve the safety, utility, environmental compatibility and affordability of general aviation aircraft. Research activities headed by NASA's Langley Research Center, Hampton, Va., and supported by Lewis Research Center, Cleveland, and Ames Research Center, Mountain View, Calif., focus on three key areas:

- o Cockpit systems such as displays, controls and software that are more "user-friendly" and cut the time needed to learn and maintain piloting skills;

- o Low-cost design and manufacturing methods and ways to make general aviation aircraft more affordable to operate; and

- o Quieter propulsion systems producing less exhaust emissions and cabins with better pilot and passenger comfort.

The General Aviation Task Force includes representatives from the General Aviation Manufacturers Association, Textron Lycoming, Allied-Signal, Honeywell, Small Aircraft Manufacturers Association, Allison, Gulfstream Aerospace, Beech Aircraft, Cirrus Design, National Business Aircraft Association, Cessna Aircraft Company, Embry-Riddle Aeronautical University, Wichita State University, FAA, National Transportation Safety Board and NASA.

- end -

EDITORS NOTE: Copies of the General Aviation Task Force Report are available from the NASA Headquarters Newsroom. Fax requests to 202/358- 4210 or -4335.

A videotape entitled, "Highways in the Sky", describes NASA research on a general aviation "cockpit of the future." The video length is 10 minutes and 37 seconds and is available to media representatives in either BETACAM SP or U-MATIC formats by calling 202/358-1733. A still photo also is available by calling 202/358-1900.

Color:
94-HC-64

B&W:
94-H-68

Donald Savage
Headquarters, Washington, D.C.
(Phone: 202/358-1547)

For Release
February 25, 1994

RELEASE: 94-30

WIND AND POLAR LAUNCHES TO SLIP FOLLOWING TECHNICAL REVIEW

The U.S. component of the Global Geospace Science (GGS) program, the Wind and Polar spacecraft, will experience launch delays of several months to give NASA an opportunity to examine the materials and process used to build two power subsystem electronic boxes on each spacecraft which are similar in design to those determined to be the cause of the NOAA-13 spacecraft failure last year.

The decision was reached by NASA after a GGS technical review last week at NASA's Goddard Space Flight Center (GSFC), Greenbelt, Md., where the projects are managed.

NASA and the spacecraft contractor, Martin Marietta Astro-Space, are using this hiatus in part to apply a corrective action plan based on lessons learned from both the NOAA-13 and the Mars Observer failure review board reports. Martin Marietta Astro-Space, who built both spacecraft which failed last year, conducted a special investigation into the failures and conducted an intensive internal review of technical concerns with the GGS spacecraft.

In addition, NASA has conducted several reviews which led to the identification of the issues which NASA has decided must be resolved before launch, including the power subsystem box.

Besides the power subsystem boxes, another issue involved parts in the command and data handling system which may have been subjected to over-stress due to calibration problems with the welding machine used to mount electrical components to circuit boards. Although a sampling of these components was originally planned to determine flight compatibility, all of these suspect components now will be changed out.

Wind and Polar, scheduled for April and June 1994 launches, respectively, will likely slip into the next fiscal year, but the exact dates will not be established until a comprehensive replan of the program is complete.

Wind and Polar will be the U.S. contribution to the International Solar-Terrestrial Physics program involving several spacecraft in a study of the interaction of the solar wind and Earth's magnetic field.

- end -



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Headquarters, Washington, D.C.
(Phone: 202/358-1983)

For Release
February 28, 1994

Lori J. Rachul
Lewis Research Center, Cleveland
(Phone: 216/433-8806)

RELEASE: C94-i

NASA AWARDS A \$52.3-MILLION CONTRACT TO A CLEVELAND FIRM

The NASA Lewis Research Center, Cleveland, has awarded Robert P. Madison International, Cleveland, a small disadvantaged business, a contract for engineering, construction and environmental services to be performed at the Lewis Research Center and at the Plum Brook Station, Sandusky, Ohio.

The cost-plus-award fee contract has a phase-in period of approximately 1 month, a basic period of 2 years and three 1-year optional renewal periods. The base contract dollar amount is \$14.6 million. The total contract value is estimated at \$52.3 million.

The contractor will perform a variety of engineering, construction and environmental services for rehabilitation, modification and construction of research and institutional facilities and systems.

The Lewis Research Center is obligating approximately \$52 million in contracts to small disadvantaged businesses from the estimated total obligations of \$655 million for fiscal year 1994.

Engineering Design Group (EDG), Tulsa, Okla., had been selected for this contract award in January 1994. The notification selecting EDG was rescinded based on a Small Business Administration, Dallas, Texas, determination that EDG exceeded the small business size standard required by the solicitation, thereby rendering them ineligible for the contract award.

- end -

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 358-1600



For Release
February 28, 1994

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Headquarters, Washington, D.C.
(Phone: 202/358-1778)

Kyle Herring
Johnson Space Center, Houston
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RELEASE: 94-31

ASTRONAUT LININGER JOINS STS-64 CREW

U.S. Navy Commander Jerry M. Lininger has been added to the crew of STS-64 as a mission specialist. The flight is scheduled for the fall of 1994 aboard Discovery.

Lininger joins USN Captain Richard N. "Dick" Richards, Commander; USAF Colonel L. Blaine Hammond, Pilot; and mission specialists USAF Colonel Carl J. Meade, USAF Lt. Col. Mark C. Lee and USAF Lt. Col. Susan J. Helms all named to the crew in November 1993.

The assignment was made to more efficiently distribute the crew workload for this complex flight, which in addition to payload operations, includes a rendezvous and proximity operations and a spacewalk. The experience gained by Dr. Lininger on this mission also will be of great value in on-going human physiology investigations, said Astronaut Office Chief Robert L. "Hoot" Gibson.

The STS-64 mission will carry the LIDAR In-Space Technology Experiment (LITE), the Robot Operated Materials Processing System (ROMPS) and the Shuttle Pointed Autonomous Research Tool for Astronomy (SPARTAN-201).

LITE will measure atmospheric parameters from a space platform utilizing laser sensors. ROMPS will investigate robot handling of thin film samples. SPARTAN is a free-flying retrievable x-ray astronomy platform.

- more -

- 2 -

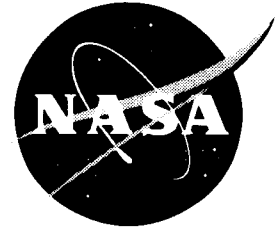
Linenger, 39, is a member of the astronaut class of 1992 and will be making his first space flight. He received a bachelor of science degree in bioscience from the U.S. Naval Academy in 1977 a doctorate in medicine from Wayne State University in 1981 a master of science degree in systems management from University of Southern California in 1988 a master of public health degree in health policy and a doctor of philosophy degree in epidemiology from the University of North Carolina in 1989. Linenger was born in Mt. Clemens, Mich., but considers Eastpointe, Mich., and Coronado, Calif., to be his hometowns.

- end -

NASA News

National Aeronautics and
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For Release
February 28, 1994

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June E. Malone
Marshall Space Flight Center, Huntsville, Ala.
(Phone: 205/544-7061)

RELEASE: 94-32

SUPER LIGHTWEIGHT EXTERNAL TANK TO BE USED BY SHUTTLE

Marshall Space Flight Center (MSFC), Huntsville, Ala., management has received approval to proceed with the development and manufacturing of an improved, lighter version of the Space Shuttle External Tank. The Super Lightweight External Tank will be fabricated of aluminum alloys and incorporate an orthogrid design for the panels which together make the tank 8,000 pounds lighter than the current configuration.

This reduction in weight can be used to increase Shuttle performance, placing typical payloads into higher orbits or at higher inclination to the Equator or placing heavier payloads into low Earth orbit. The Super Lightweight Tank development and production will enhance the Space Shuttle's capability to support the Space Station deployment.

The existing contract for the tank with Martin Marietta will be modified, enabling the contractor to make the required changes. The first Super Lightweight Tank is scheduled for delivery in 1997, with External Tank-96 projected as the first aluminum lithium tank.

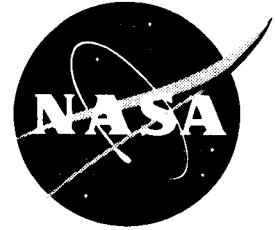
Testing of the new configuration will be accomplished at MSFC. The program development cost is estimated at \$172.5 million. Each Super Lightweight Tank produced will cost approximately \$59 million.

- end -

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202 358-1600



For Release

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March 3, 1994

Barbara Schwartz
Johnson Space Center, Houston
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RELEASE: 94-33

RESEARCHER DEVELOPS 1993 INVENTION OF THE YEAR

A system for controlling microbial contamination in drinking water, developed jointly by a NASA engineer and two contractor employees, has been selected as both the NASA Invention of the Year and the NASA Commercial Invention of the Year.

Richard L. Sauer of the Johnson Space Center, Houston, along with co-inventors Gerald V. Colombo and Clifford D. Jolly of Umpqua Research Co., Myrtle Creek, Ore., developed the Regenerable Biocide Delivery Unit for use during future long-term space missions.

This process is an extension of the microbial check valve technology currently in use on board the Space Shuttle. The technology also has applications for long-term space flight.

"The life of an iodinated resin bed for purifying water has been limited until now," Sauer said. With the new system, the purifying resin bed can be regenerated in flight using small amounts of elemental iodine. "For space flights or space station missions lasting more than 60 days, a substantial weight savings can be realized by carrying a small amount of elemental iodine to regenerate the new system where we previously had to fly a complete replacement unit," Sauer said.

"I believe there is a valuable commercial application for this unit, particularly in developing nations where the need for microbial control of water supplies is very critical," Sauer said. Microbial contamination is caused by micro-organisms, especially pathogenic bacterium, that can infiltrate a water supply.

"This is an effective alternative that doesn't have the drawbacks of the hazardous gases affiliated with purification systems that use chlorine or other traditional methods. This is a totally different technology than that used in chlorination systems," Sauer said.

-more-

Using elemental iodine to regenerate a resin bed eliminates the dangers common in the use of chlorine including overtreating the water supply and the storage and use of the hazardous chlorine gas. The system is scalable up to municipal water treatment size, creating commercial applications that also could be of benefit during times of flood or other natural disasters.

"A resin bed containing iodine can be stored safely for a long time," Sauer said. That extended shelf-life has the benefit of making the resin bed available on short notice in emergency situations, such as flooding or other natural disasters that impact the potable water supply.

According to Sauer, the development of this unit builds on earlier research by Dr. Jack Lambert and Dr. Louis Fina of Kansas State University and a number of technologies developed over the past 20 years.

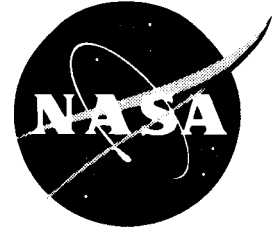
Sauer is the Deputy Chief of the Biomedical Operations and Research Branch at the Johnson Space Center. A 27-year veteran of the center, his primary efforts have been directed at the biomedical aspects of manned spaceflight. He also serves as NASA's expert for establishing spaceflight water potability and monitoring standards, as well as directing the sampling and analysis of Space Shuttle potable water samples.

He graduated from the University of Notre Dame with a bachelor of science degree in 1962 and received a master of science degree from the University of California in 1974. He is married to the former Chris Sherman.

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202 358-1600



For Release

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March 3, 1994

Franklin O'Donnell
Jet Propulsion Laboratory, Pasadena, Calif.
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RELEASE: 94-34

GALILEO SPACECRAFT SIGHTS PROBABLE MOON OF ASTEROID IDA

NASA's Galileo spacecraft observed what is probably a natural satellite of the asteroid Ida -- which would be the first moon of an asteroid ever sighted -- during the spacecraft's flyby of Ida last August 28.

The object is revealed in data samples now being transmitted by the spacecraft and analyzed by scientists at NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif.

Sampled data from both Galileo's solid-state imaging system and its near-infrared mapping spectrometer give indications of the object.

Because Galileo has been transmitting data back to Earth at a low rate of 40 bits per second, a complete image of the suspected moon will first become available in about 3 weeks.

Galileo has completed nearly 90 percent of its 2.4-billion-mile (3.8-billion-kilometer) journey to Jupiter. Galileo will go into orbit around the giant planet after exploring the atmosphere with an instrumented probe on Dec. 7, 1995.

JPL manages the Galileo Project for NASA's Office of Space Science, Headquarters, Washington, D.C.

- end -

Jim Cast

Headquarters, Washington, D.C.
(Phone: 202/358-1779)

For Release

March 7, 1994

Jerry Berg/Dave Drachlis

Marshall Space Flight Center, Huntsville, Ala.
(Phone: 205/544-0034)

RELEASE: 94-35

DATE SET FOR SECOND FLIGHT OF TETHER EXPERIMENT

The second mission of NASA's Small Expendable-tether Deployer System (SEDS-2) is scheduled to be launched no earlier than 10:32 p.m. EST March 9 from Space Launch Complex 17 at the Cape Canaveral Air Force Station, Fla. It will be a secondary payload on a U.S. Air Force Delta II rocket carrying a NAVSTAR Global Positioning System Satellite.

Deployment of the SEDS-2 payload is planned to begin approximately 66 minutes after the Delta liftoff. The instrumented package is to unreel for an additional 109 minutes, reaching a maximum planned distance of 12.4 miles (20 km) from the deployer, in a downward (toward Earth) direction.

The SEDS project is intended to demonstrate a versatile and economical way of delivering smaller payloads, such as micro-satellites, to higher orbits or downward toward Earth's atmosphere. The second mission will investigate how well SEDS permits controlling the dynamics of payload deployment.

The SEDS project is sponsored by NASA's Office of Space Systems Development in Washington, D.C., and is managed by the Marshall Center in Huntsville, Ala. The payload is managed and developed by the Langley Research Center in Hampton, Va. The Goddard Space Flight Center in

-more-

- 2 -

Greenbelt, Md., is responsible for integrating SEDS with the launch vehicle. Tether Applications in Chula Vista, Calif., is the inventor and developer of SEDS.

Editor's Note: There will be no NASA news center in operation for the SEDS-2 mission. However, following the deployment, news media with questions may call 205/544-0034. Also, a written status report concerning the outcome of the SEDS mission will be distributed by fax as soon as possible after results are known. Media wishing to receive the status report should provide a fax number to the Marshall Space Flight Center Media Services office by calling 205/544-0034.

- end -

Dwayne C. Brown
Headquarters, Washington, D.C.
(Phone: 202/358-0547)

For Release
March 7, 1994

RELEASE: 94-36

NEW TECHNOLOGY TO BE TESTED FOR NASA SAFETY OFFICE

NASA's Office of Safety and Mission Assurance (OSMA), Washington, D.C., will obtain valuable data from a flight test of a new laser-diode initiated ordnance system on Orbital Sciences Corp. (OSC) Pegasus air-launch space booster from Vandenberg AFB, Calif., in June. The system is essential to OSMA's goal of using faster, better and cheaper systems in space and aeronautic systems.

"A successful test of the system will allow future spacecraft to perform operations more efficiently and safely, " said Fred Gregory, Associate Administrator for the OSMA.

The system is part of OSMA's Laser Initiated Ordnance System Validation Program and until now the absence of operational experience and critical test data was the major hurdle preventing the use of the system for future NASA activities. The system can be used for a variety of pyrotechnic applications such as escape systems, spacecraft separation devices and flight termination systems. Currently, NASA and industry rely on electric current to activate these mechanisms which require many safeguards to avoid accidentally setting off the initiators.

Under the planned concept, the laser initiated system may replace electrical bridgewire initiation systems to reduce hazards from electromagnetic interference and develop systems with no moving parts to increase reliability of electrical systems.

"The safety record using electric current is excellent because there are many elaborate safeguards designed to avoid accidental ignition. However, the laser initiated ordnance will improve design, testing and operations to achieve an even higher level of safety," said Norm Schulze, Manager of Safety, Reliability and Quality Assurance Technologies, OSMA.

-more-

Ensign Bickford, Inc., Simsbury, Conn., developed the system and will test the technology for NASA. OSC will provide the flight vehicle at no cost to NASA while costs to integrate the system demonstration will be funded by OSMA. Results of the test will be transferred to industry and NASA.

"Government and industry will work as a team to test and conduct the flight demonstration of the system. Industry will be able to market the product and NASA would have demonstrated the system's technical feasibility, safety and the potential for cost savings on future spacecraft and aeronautical systems," Schulze said.

-end-

For Release

Dwayne C. Brown
Headquarters, Washington, D.C.
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March 8, 1993

RELEASE: 94-37

NASA/DOD TO ESTABLISH STANDARD QUALITY ASSURANCE REQUIREMENTS

NASA and the Department of Defense (DOD) have instituted policies that will lead to standardized requirements to improve the quality of contractor-delivered products to both agencies.

"In many cases, government agencies rely on the same contractors for products, but impose different quality requirements. This results in increased inefficiencies and cost. Standard quality requirements will result in improved contractor efficiencies at reduced costs," said Fred Gregory, Associate Administrator for the Office of Safety and Mission Assurance (OSMA).

Prior to the policies, a NASA and DOD joint working group developed a handbook to provide guidance in using quality methods. These standards were developed for international and national agencies respectively to establish standard quality requirements.

"The uniqueness of NASA and DOD programs and our own strict quality standards prevented using the national standards. However, NASA and DOD's handbook and subsequent policies give approval to use those quality standards. This will enable NASA and DOD contractors to consolidate their quality procedures that will improve product quality and enhance international competitiveness for our contractors," said Carl Schneider, Deputy Director, Engineering and Quality Management.

NASA's requirements will enable the agency to maximize the use of commercial specifications and standards for new programs, follow-on procurements for existing programs and current contracts. These requirements will include planning and engineering, inspection and testing, product review, training and many other aspects of quality control.

OSMA also is assessing other NASA safety and quality policies that could be replaced with existing national non-government, DOD or federal standards.

-end-

NASA News

National Aeronautics and
Space Administration

Washington, D.C. 20546
AC 202 453-8400



Jim Cast
Headquarters, Washington, D.C.
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For Release
March 9, 1994

N94-20: NOTE TO EDITORS

ACCESS TO SPACE STUDY AVAILABLE

NASA's "Access to Space Study," undertaken in response to a congressional request in the NASA FY 1993 appropriations act, is available at the NASA Headquarters newsroom, 300 E Street, S.W., Washington, D.C. (202/358-1600).

The report summarizes the results of a comprehensive NASA in-house study to identify and assess alternate approaches to access space through the year 2030 and to select and recommend a preferred course of action.

Copies of the report are also available at the Marshall Space Flight Center, Huntsville, Ala., newsroom and will be available at other NASA center newsrooms within 3 days.

-end -

94-38

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

SPACE SHUTTLE MISSION STS-59

PRESS KIT
APRIL 1994



SPACE RADAR LABORATORY-1

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June Malone Marshall Space Flight Center, Huntsville, Ala.	External Tank/SRBs/SSMEs	205/544-0034
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For Information on NASA-Sponsored STS-59 Experiments

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Jane Hutchison Ames Research Center, Mountain View, Calif.	TUFI Experiment	415/604-4968

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RELEASE: 94-38

SPACE RADAR HIGHLIGHTS SHUTTLE MISSION STS-59

In April 1994, scientists around the world will be provided a unique vantage point for studying how the Earth's global environment is changing when Space Shuttle Endeavour is launched on Shuttle mission STS-59. During the 9-day mission, the Space Radar Laboratory (SRL) payload in Endeavour's cargo bay will give scientists highly detailed information that will help them distinguish human-induced environmental changes from other natural forms of change.

NASA will distribute the data to the international scientific community so that this essential research is available worldwide to assist people in making informed decisions about protecting the environment.

Leading the STS-59 crew will be Mission Commander Sidney M. Gutierrez who will be making his second flight. Pilot for the mission is Kevin P. Chilton who is making his second flight. The four mission specialists aboard Endeavour are Linda M. Godwin, the STS-59 Payload Commander, who will be making her second flight; Jerome Apt who will be making his third flight; Michael R. "Rich" Clifford who will be making his second flight; and Thomas D. Jones who will be making his first flight.

Launch of Endeavour on the STS-59 mission currently is scheduled for no earlier than April 7, 1994, at 8:07 a.m. EDT. The planned mission duration is 9 days, 5 hours, 7 minutes. An on-time launch on April 7 would produce a landing at 1:14 p.m. EDT on April 16 at the Kennedy Space Center's Shuttle Landing Facility.

The Space Radar Laboratory (SRL) payload is comprised of the Spaceborne Imaging Radar-C/X-Band Synthetic Aperture Radar (SIR-C/X-SAR) and the Measurement of Air Pollution from Satellite (MAPS). The German Space Agency (DARA) and the Italian Space Agency (ASI) are providing the X-SAR instrument.

The imaging radar of the SIR-C/X-SAR instruments have the ability to make measurements over virtually any region at any time, regardless of weather or sunlight conditions. The radar waves can penetrate clouds, and under certain conditions, can also "see" through vegetation, ice and extremely dry sand. In many cases, radar is the only way scientists can explore inaccessible regions of the Earth's surface.

An international team of 49 science investigators and three associates will conduct the SIR-C/X-SAR experiments. Thirteen nations are represented: Australia, Austria, Brazil, Canada, China, the United Kingdom, France, Germany, Italy, Japan, Mexico, Saudi Arabia and the United States.

The MAPS experiment will measure the global distribution of carbon monoxide in the troposphere, or lower atmosphere. Measurements of carbon monoxide, an

important element in several chemical cycles, provide scientists with indications of how well the atmosphere can clean itself of "greenhouse gases," chemicals that can increase the atmosphere's temperature.

STS-59 will see the continuation of NASA's Get Away Special (GAS) experiments program. The project gives the average person a chance to perform experiments in space on a Shuttle mission. There are three GAS payloads on this flight: a New Mexico State University experiment to examine the freezing and crystallization process of water in space; an experiment to explore thermal conductivity measurements on liquids in microgravity sponsored by the Matra Marconi Space of Paris, France; and the Society of Japanese Aerospace Companies, Inc., experiment to find out whether small fruiting bodies can be obtained in microgravity.

The STS-59 mission will fly the first cooperative initiative with the National Institutes of Health (NIH). The joint initiative in cell biology will use a special cell culture system developed by the Walter Reed Army Institute of Research, Washington, D.C. The system known as Space Tissue Loss-4/National Institutes of Health-1 will examine the effects of microgravity on muscle and bone cells. Preliminary flight tests using this cell culture system have indicated there may be effects in the rate in which new muscle and bone cells are formed in microgravity. This research will help understand what is happening on the cellular level of astronauts who suffer from bone loss and muscle deterioration during spaceflight. This research also should contribute to scientists understanding of the mechanisms involved in bone loss and muscle atrophy here on Earth.

An advanced cell culture device known as STL-5 will be flown on STS-59. This is the first flight test of this hardware developed by the Walter Reed Army Institute of Research. This new system includes a video-microscope that will allow scientists on the ground to see real-time video images of their experiments in space. The instrument is designed to be controlled by either astronauts in space or individuals on the ground. This telescience from the middeck opens up the possibility for scientists to monitor and control their space experiments from the ground. The objective of this flight is to test the operation of the equipment in microgravity. Fish eggs will be used to test the imaging capability of the system.

The Endeavour crew will take on the role of teacher as they educate students in the United States, Finland and Australia about STS-59 mission objectives and what it is like to live and work in space through the Shuttle Amateur Radio Experiment-II (SAREX-II). Shuttle mission specialists Linda Godwin and Jay Apt will operate the SAREX equipment.

STS-59 will be the 6th flight of Space Shuttle Endeavour and the 62nd flight of the Space Shuttle system.

- end -

MEDIA SERVICES INFORMATION

NASA Select Television Transmission

NASA Select television is available through Spacenet-2, Transponder 5, located at 69 Degrees West Longitude with horizontal polarization. frequency is 3880.0 MHz, audio is 6.8 MHz.

The schedule for television transmissions from the Shuttle orbiter and for mission briefings will be available during the mission at Kennedy Space Center, Fla; Marshall Space Flight Center, Huntsville, Ala.; Dryden Flight Research Center, Edwards, Calif.; Johnson Space Center, Houston, and NASA Headquarters, Washington, D.C. The television schedule will be updated to reflect changes dictated by mission operations.

Television schedules also may be obtained by calling COMSTOR 713/483-5817. COMSTOR is a computer data base service requiring the use of a telephone modem. A voice report of the television schedule is updated daily at noon Eastern time.

Status Reports

Status reports on countdown and mission progress, on-orbit activities and landing operations will be produced by the appropriate NASA newscenter.

Briefings

A mission briefing schedule will be issued prior to launch. During the mission, status briefings by a flight director or mission operations representative and when appropriate, representatives from the payload team, will occur at least once per day. The updated NASA Select television schedule will indicate when mission briefings are planned.

STS-59 QUICK LOOK

Launch Date/Site: April 7, 1994/Kennedy Space Center, Fla. - Pad 39A
Launch Time: 8:07 a.m. EDT
Orbiter: Endeavour (OV-105) - 6th Flight
Orbit/Inclination: 120 nautical miles/57 degrees
Mission Duration: 9 days, 5 hours, 7 minutes
Landing Time/Date: 1:14 p.m. EDT April 16, 1994
Primary Landing Site: Kennedy Space Center, Fla.
Abort Landing Sites: Return to Launch Site - KSC, Fla.

TransAtlantic Abort landing - Zaragoza, Spain
Moron, Spain
Ben Guerir, Morocco
Abort Once Around - White Sands, N. M.

Crew: Sidney M. Gutierrez, Commander (CDR)
Kevin P. Chilton, Pilot (PLT)
Jerome Apt, Mission Specialist 1 (MS1)
Michael R. Clifford, Mission Specialist 2 (MS2)
Linda M. Godwin, Payload Commander (MS3)
Thomas D. Jones, Mission Specialist 4 (MS4)

Red shift: Gutierrez, Chilton, Godwin
Blue shift: Apt, Clifford, Jones

Cargo Bay Payloads: Space Radar Laboratory-1 (SRL-1)
Consortium for Materials Development in Space
Complex Autonomous Payload-IV (CONCAP-IV)
Get-Away Special Bridge Assembly/Canisters
(GAS Bridge/Cans: G-203, G-300, G-458)

Middeck Payloads: Space Tissue Loss (STL)
Shuttle Amateur Radio Experiment-II (SAREX-II)
Toughened Uni-Piece Fibrous Insulation (TUFI)
Visual Function Tester-4 (VFT-4)

Detailed Test Objectives/Detailed Supplementary Objectives:

DTO 301D: Ascent Wing Structural Capability
DTO 305D: Ascent Compartment Venting Evaluation
DTO 306D: Descent Compartment Venting Evaluation
DTO 307D: Entry Structural Capability
DTO 312: External Tank Thermal Protection System Performance
DTO 414: Auxiliary Power Unit Shutdown Test
DTO 521: Orbiter Drag Chute System
DTO 653: Evaluation of the MK 1 Rowing Machine
DTO 656: Payload and General Purpose Support Computer Single
Event Upset Monitoring
DTO 663: Acoustical Noise Dosimeter Data
DTO 664: Cabin Temperature Survey

DTO 665: Acoustical Noise Sound Level Data
DTO 674: Thermo-electric Liquid Cooling System Evaluation
DTO 700-8: Global Positioning System Development Flight Test
DTO 805: Crosswind Landing Performance
DSO 326: Window Impact Observations
DSO 483: Back Pain in Microgravity
DSO 487: Immunological Assessment of Crewmembers
DSO 488: Measurement of Formaldehyde Using Passive Dosimetry
DSO 603B: Orthostatic Function During Entry, Landing and Egress
DSO 604: Visual-Vestibular Integration as a Function of Adaptation
DSO 608: Effects of Space Flight on Aerobic and Anaerobic
Metabolism During Exercise
DSO 611: Air Monitoring Instrument Evaluation and Atmosphere
Characterization
DSO 621: In-Flight Use of Florinef to Improve Orthostatic
Intolerance Postflight
DSO 624: Pre- and Postflight Measurement of Cardiorespiratory
Responses to Submaximal Exercise
DSO 626: Cardiovascular and Cerebrovascular Responses to Standing
Before and After Space Flight
DSO 802: Educational Activities
DSO 901: Documentary Television
DSO 902: Documentary Motion Picture Photography
DSO 903: Documentary Still Photography

SPACE SHUTTLE ABORT MODES

Space Shuttle launch abort philosophy aims toward safe and intact recovery of the flight crew, orbiter and its payload. Abort modes include:

- **Abort-To-Orbit (ATO)** -- Partial loss of main engine thrust late enough to permit reaching a minimal 105-nautical-mile orbit with orbital maneuvering system engines.
- **Abort-Once-Around (AOA)** -- Earlier main engine shutdown with the capability to allow one orbit around before landing at White Sands Space Harbor, N. M.
- * **TransAtlantic Abort Landing (TAL)** -- Loss of one or more main engines midway through powered flight would force a landing at either Zaragoza, Spain; Moron, Spain; or Ben Guerir, Morocco.
- * **Return-To-Launch-Site (RTL)** -- Early shutdown of one or more engines, and without enough energy to reach Zaragoza, would result in a pitch around and thrust back toward KSC until within gliding distance of the Shuttle Landing Facility.

STS-59 contingency landing sites are the Kennedy Space Center, White Sands Space Harbor, Zaragoza, Moron and Ben Guerir.

STS-59 SUMMARY TIMELINE

Flight Day One

Ascent

OMS-2 burn (120 n.m. x 119 n.m.)

SRL-1 activation/operations

GAS activities

Blue Flight Day Two

SRL operations

SAREX-II setup

Red Flight Day Two

SRL operations

Blue Flight Day Three

SRL operations

VFT-4 activities

Red Flight Day Three

SRL operations

Blue Flight Day Four

SRL operations

VFT activities

MS-4 off duty (half-day)

Red Flight Day Four

SRL operations

GAS activities

Blue Flight Day Five

SRL operations

STL activities

MS-2 off duty (half-day)

Red Flight Day Five

SRL operations

MS-3 off duty (half-day)

VFT activities

Blue Flight Day Six

SRL operations

MS-1 off duty (half-day)

VFT activities

Red Flight Day Six

SRL operations

VFT activities

PLT off duty (half-day)

Blue Flight Day Seven

SRL operations

VFT activities

Red Flight Day Seven

SRL operations

VFT activities

CDR off duty (half-day)

Blue Flight Day Eight

SRL operations

VFT activities

Red Flight Day Eight

SRL operations

VFT activities

Blue Flight Day Nine

SRL operations

VFT activities

Red Flight Day Nine

Flight Control Systems checkout

Reaction Control System hot-fire

SRL operations

STL deactivation

GAS deactivation

SRL deactivation

Cabin stow

Blue/Red Flight Day Ten

Final payload deactivation

Cabin stow

Deorbit preparation

Deorbit burn

Entry

Landing

STS-59 VEHICLE AND PAYLOAD WEIGHTS

Vehicle/Payload	Pounds
Orbiter (Endeavour) empty and 3 SSMEs	173,669
Space Radar Lab-1	21,379
Space Radar Lab-1 support equipment	2,417
CONCAP-IV	512
Get-Away Specials and support equipment	1,702
Space Tissue Loss	132
Visual Function Tester	32
Shuttle Amateur Radio Experiment	34
Detailed Supplementary/Test Objectives	113
Total Vehicle at SRB Ignition	4,510,987
Orbiter Landing Weight	221,708

STS-59 ORBITAL EVENTS SUMMARY

EVENT	START TIME (dd/hh:mm:ss)	VELOCITY CHANGE (feet per second)	ORBIT (n.m.)
OMS-2	00/00:33:00	164 fps	120 x 121
Deorbit	09/04:04:12	294 fps	N/A
Touchdown	09/05:07:00	N/A	N/A

STS-59 CREW RESPONSIBILITIES

TASK/PAYLOAD	PRIMARY	BACKUPS/OTHERS
Shift CDR	Gutierrez (red)	Apt (blue)
SRL-1	Godwin (red)	Jones (blue)
CONCAP	Chilton	Apt
GAS cans	Chilton	Apt

Middeck Payloads:

SAREX	Apt	Godwin
STL	Chilton	Clifford
VFT	Gutierrez	Apt

Detailed Test Objectives:

DTO 301D	Chilton	
DTO 305D	Chilton	
DTO 306D	Chilton	
DTO 307D	Chilton	
DTO 312	Apt	
DTO 414	Chilton	
DTO 521	Chilton	
DTO 653	Gutierrez	
DTO 656	Godwin	Jones
DTO 663	Gutierrez	Apt
DTO 664	Gutierrez	Apt
DTO 665	Gutierrez	Apt
DTO 700-8	Jones	

Detailed Supplementary Objectives:

DSO 326	Chilton, Clifford	
DSO 483	Gutierrez, Apt, Clifford, Godwin	
DSO 487	All	
DSO 488	Gutierrez, Clifford	
DSO 603B	Godwin	
DSO 604-1	Chilton, Clifford	
DSO 604-3	Chilton, Godwin	
DSO 608	Chilton	
DSO 611	Chilton, Apt	
DSO 621	Godwin	
DSO 624	Gutierrez, Apt, Clifford, Jones	
DSO 626	Chilton, Godwin	
DSO 802	Apt	
DSO 901	Apt	Chilton
DSO 902	Apt	Chilton
DSO 903	Apt	Chilton

Other:

Photography/TV	Apt	Chilton
In-Flight Maintenance	Gutierrez, Chilton (red)	Apt, Clifford (blue)
EVA	Godwin (EV1)	Jones (EV2), Chilton
Earth Observations (SRL)	Jones	Godwin
Earth Observations (other)	Apt	
Medical	Gutierrez	Clifford

SPACE RADAR LABORATORY-1

The Space Radar Laboratory-1 (SRL-1) comprises two elements: a suite of radar instruments called Spaceborne Imaging Radar-C/X-Band Synthetic Aperture Radar (SIR-C/X-SAR) jointly developed by NASA with DARA of Germany and ASI of Italy, and an atmospheric instrument called Measurement of Air Pollution from Satellite (MAPS). SRL is part of NASA's Mission to Planet Earth, the agency's program that is studying how our global environment is changing. SRL is scheduled to fly twice in 1994 aboard the Space Shuttle Endeavour.

From the unique vantage point of space, Mission to Planet Earth flights will observe, monitor and assess large-scale environmental processes with a focus on global change. The spacecraft data, complemented by aircraft and ground studies, will give scientists highly detailed information that will help them distinguish human-induced environmental changes from other natural forms of change. NASA will distribute the Mission to Planet Earth data to the international scientific community so that this essential research is available worldwide to assist people in making informed decisions about protecting their environment.

Why Radar?

The most useful feature of imaging radar is its ability to make measurements over virtually any region at any time, regardless of weather or sunlight conditions. The radar waves can penetrate clouds and under certain conditions, can also "see" through vegetation, ice and extremely dry sand. In many cases, radar is the only way scientists can explore inaccessible regions of Earth's surface.

The SIR-C/X-SAR is a synthetic aperture radar that transmits pulses of microwave energy from the Shuttle toward Earth and measures the strength and time delay of the energy that is scattered back to the SIR-C/X-SAR antenna. The motion of the Shuttle between the transmission of the beam and the receipt of the backscattered radiation is used to "synthesize" or create an antenna (the aperture) much longer than the actual antenna hardware. The effect of the longer antenna is to produce images of finer resolution.

Conditions on the Earth's surface influence how much radar energy is reflected back to the antenna. An area with a variety of surface types, such as hills, trees and large rocks, generally will reflect more energy back to the radar than a less complex area such as a desert. The resulting radar image of the varied terrain will appear brighter overall than the image of the simpler area. The three frequencies of SIR-C/X-SAR will enable scientists to view three different scales of features in the images.

Science Objectives

The SIR-C/X-SAR radar data will provide information about how elements of the complex "Earth system" — particularly land surfaces, water and life — work together to create Earth's livable environment. The science team is particularly interested in studying vegetation coverage, the extent of snow packs, wetland areas, geologic

features such as rock types and their distribution, volcanic processes, ocean wave heights and wind speeds.

There are more than 400 sites on Earth where data will be taken during the mission. Nineteen of these have been designated as "supersites," making them the highest priority targets and the focal point for many of the scientific investigators. There are an additional 15 backup supersites.

The supersites were chosen to represent different environments within each scientific discipline, and they are areas where intensive field work will occur before, during and after the flight.

During the mission, "ground truth" teams at different sites will make ground- or sea-based measurements of vegetation, soil moisture, sea state, snow and weather conditions as the Shuttle passes over their sites. These data will be supplemented with information taken from aircraft and ships to ensure an accurate interpretation of the data taken from space. In addition, the STS-59 astronauts will record their personal observations of weather and environmental conditions in coordination with SIR-C/X-SAR operations.

The following are the areas of investigations and supersites for the SRL mission:

Ecology: Manaus, Brazil; Raco, Mich.; Duke Forest, N.C.; Central Europe

Ecologists study life on Earth and how different species of animals and plants interact with one another and their local environment. SIR-C/X-SAR will collect ecological data over the tropical forests of the Amazon basin in South America and over the temperate forests of North America and Central Europe.

The radar images will be used to study land use, the volume, types and extent of vegetation and the effects of fires, floods and clear-cutting. SIR-C/X-SAR's three radar frequencies interact with the vegetation on different scales, providing three independent views of the forest.

The radar's multi-polarization ability allows scientists to look beneath the thick vegetation canopy of the forest in cloud-covered regions of the world to study the trunks of the trees, which have stronger reflection of vertically-oriented waves as well as the tree branches, which reflect the horizontal waves more strongly. These data give scientists a more complete picture of the conditions on the ground.

In some cases, SIR-C/X-SAR data will be used to test or validate existing computer models of these areas that identify different kinds of trees, classify crop types and determine the amount of soil moisture available in certain areas.

Seasonal changes in the forest will be studied by comparing data from the two SIR-C/X-SAR flights in April and August. SIR-C/X-SAR data will be used along with ground truth data to understand the impact of the loss of forests on local ecology. Scientists also will use the data to understand the impact on animals.

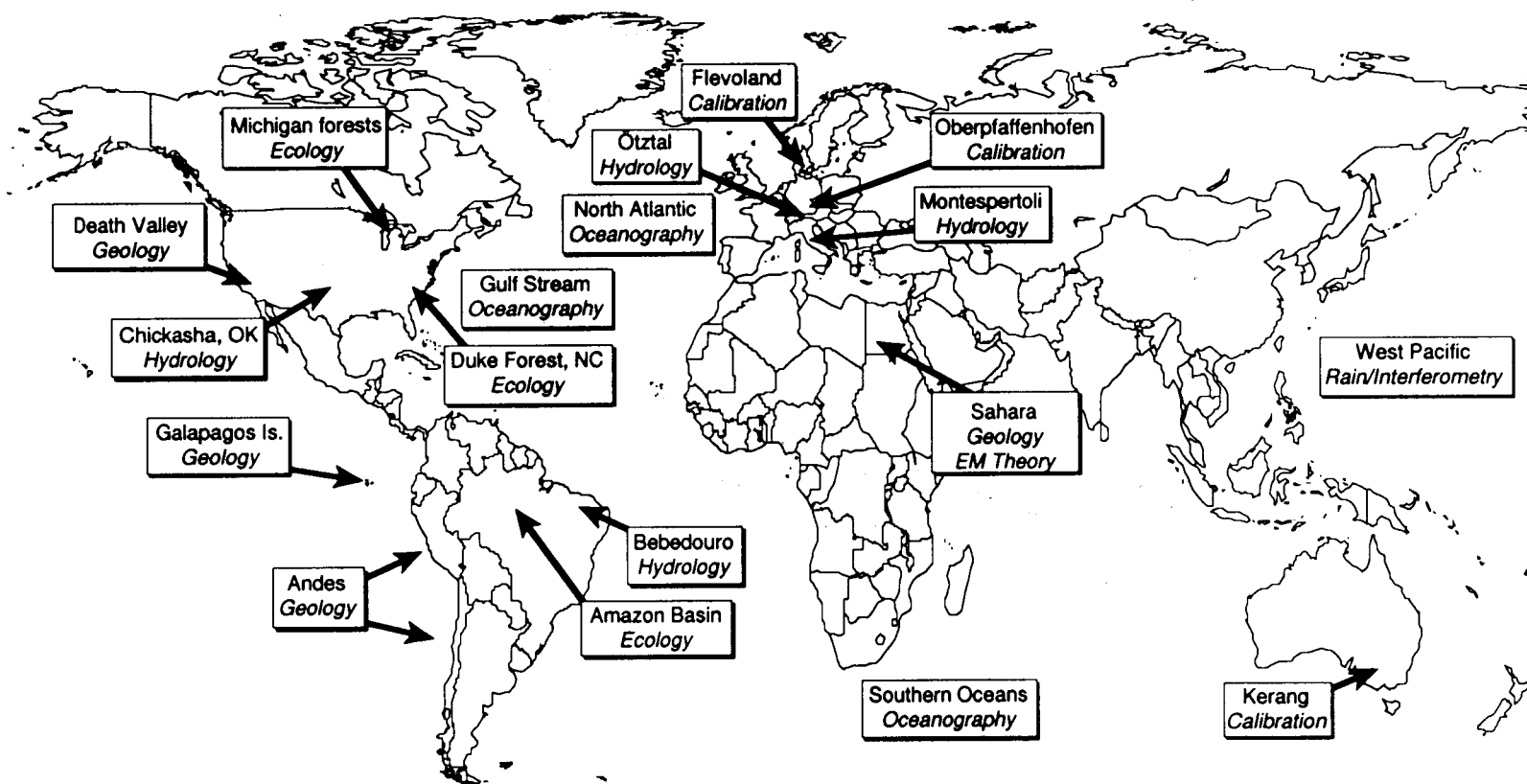


Space Radar Laboratory

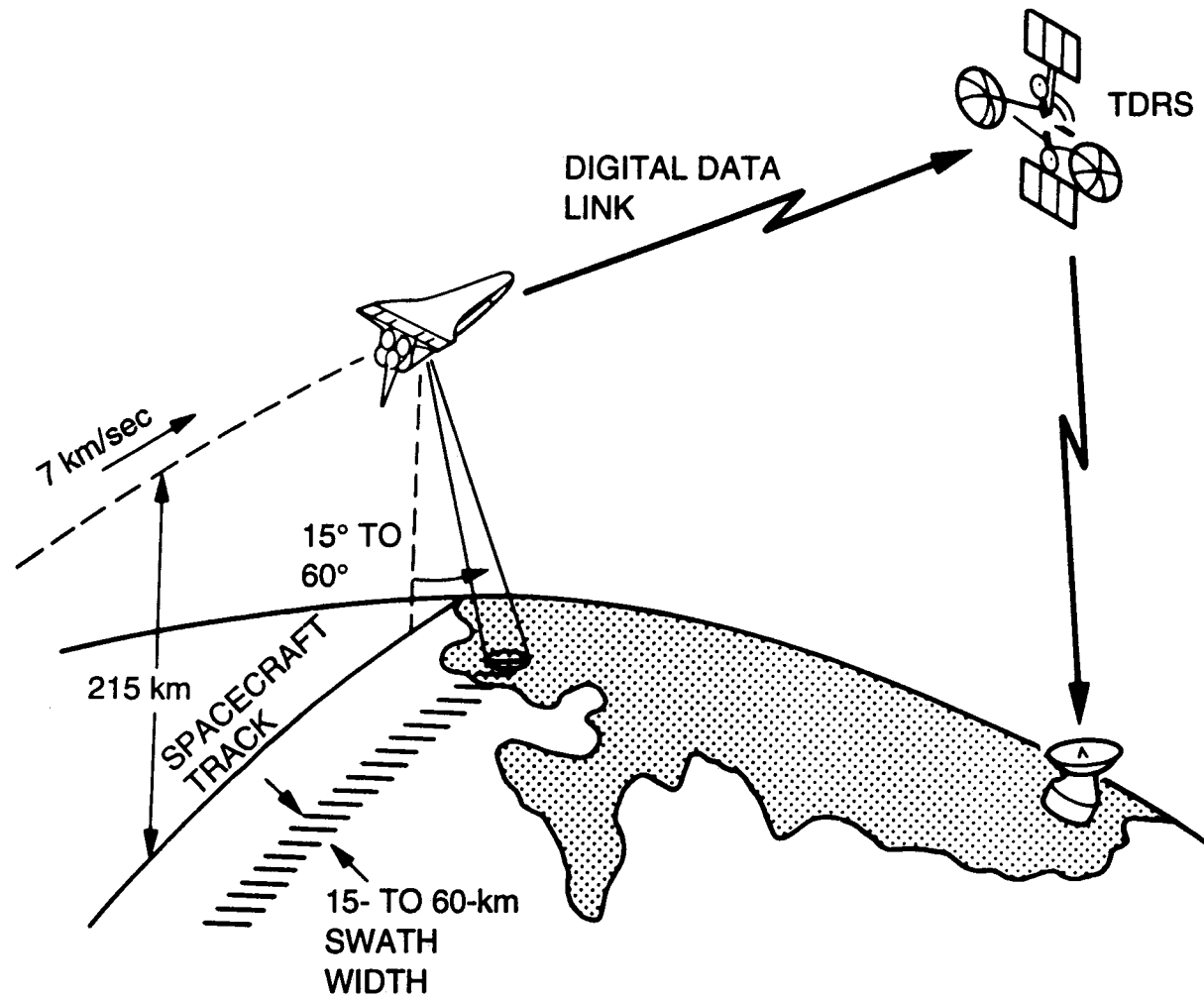
SIR-C / X-SAR SCIENCE

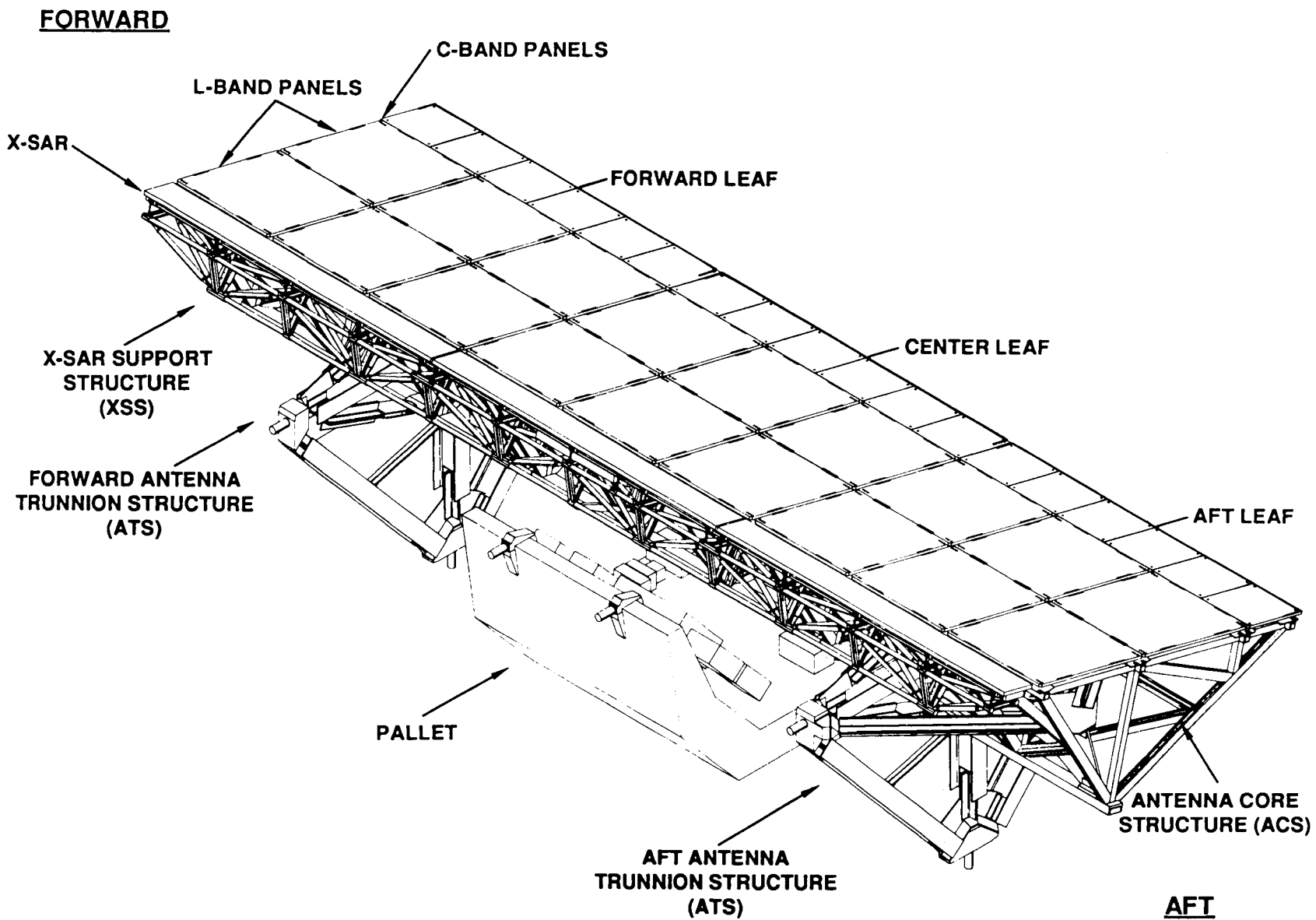


- 49 PRINCIPAL INVESTIGATORS, 3 TEAM ASSOCIATES, 100+ SCIENTISTS, INCLUDING CO-I's
- 13 COUNTRIES REPRESENTED
- 19 PRIMARY OBSERVATION SITES (SUPERSITES)



THE SIR-C/X-SAR MISSION





By studying the short-term and long-term changes in forests, scientists can determine what effects changing environmental conditions and land use have on the forests and in turn, on global climate change.

Hydrology: Chickasha, Okla.; Otztal, Austria; Bebedouro, Brazil; Montespertoli, Italy

SIR-C/X-SAR hydrology investigations, which study how water circulates on land, will be focused on determining soil moisture patterns. These studies will help scientists develop ways to estimate soil moisture — the "hidden" water that plays a major role in determining whether a region is wet or dry and influences the global distribution of energy. Combined with information on evaporation rates over large areas, this data ultimately will be incorporated into computer models to help predict a region's water cycle.

The radars also will acquire snow cover data over Mammoth Lakes, Calif., the Austrian Alps and the Patagonian district in southern Chile. The shorter wavelength X-band data will be useful to scientists for determining snow type, while the longer wavelengths of L-band and C-band will help them estimate snow volume.

Snow data will help communities determine how much water will be available for human and agricultural use. For many areas, long-term or ground-based snow cover data do not exist, and using radar data is the only way to collect this information.

SIR-C/X-SAR also will study wetlands -- delicate ecosystems especially vulnerable to changes introduced by humans. Wetlands are the source of many trace gases that play an important part in the global atmospheric cycle. SIR-C/X-SAR will be able to determine the extent and limits of selected wetland areas because radar is extremely sensitive to the presence of standing water, even hidden under vegetation cover. Data from the multiple flights of SIR-C/X-SAR will help scientists observe changes in wetlands over time.

Oceanography: The Gulf Stream (mid-Atlantic region); Northeast Atlantic Ocean, Southern Ocean.

SIR-C/X-SAR will observe surface and internal waves, wind motion at the sea surface and ocean currents. These data will help scientists study how the Earth's climate is moderated by the ocean, particularly heat-transporting currents like the U.S. Gulf Stream.

Geology: Galapagos Islands; Sahara Desert; Death Valley, Calif.; Andes Mountains, Chile; Mount Pinatubo

SIR-C/X-SAR will map geologic structures and variations in rock types over large areas, including areas of volcanic activity and erosion. These data will be especially useful in areas of heavy vegetation and continuous cloud cover, where field work is often difficult.

The longer L-band radar wavelengths are particularly useful for looking beneath surfaces, and SIR-C/X-SAR will continue the radar penetration studies that began with SIR-A. SIR-A demonstrated the ability of imaging radar to penetrate extremely dry surfaces and discovered ancient river channels in portions of the Sahara, which have evolved from areas of flowing streams to what is now an arid desert. SIR-C/X-SAR will study such paleoclimatic sites in the Sahara Desert and Saudi Arabia.

SIR-C/X-SAR also will study other geologic features that record past climate changes. In Death Valley, Calif., western China and the southern Andes, the radar will map gravel deposits that wash down from the mountains to form alluvial fans. The fans are found throughout the semi-arid deserts of the world in areas where there is a significant amount of geologic activity. Gravel builds up at the base of the mountains during periods of relatively wet climate.

The radar is sensitive to these rocky and rough surfaces, allowing scientists to study climate history and the relative ages of surfaces. As an area ages, it is exposed to weathering. This changes its roughness characteristics. Mapping areas of past climate change will give scientists a stronger base from which to monitor and predict future climate changes.

SIR-C/X-SAR will image volcanoes, including Mount Pinatubo and the volcanoes of the Galapagos Islands. Volcanic eruptions can have a significant impact on Earth's atmosphere, and SIR-C/X-SAR may obtain radar images of erupting volcanoes and fresh lava flows which would help scientists understand volcanic evolution. The likelihood of finding an active volcano during the flight is very good since active volcanoes are observed on nearly 50 percent of Shuttle flights.

Calibration: Flevoland, The Netherlands; Kerang, Australia; Oberpfaffenhofen, Germany; Western Pacific Ocean

Ground equipment will be set up in southern Germany, The Netherlands, Australia and Death Valley, Calif., to measure the amount of SIR-C/X-SAR radar energy received at the ground during the flight. This information will be used after the mission when the radar data are being processed to help scientists calibrate the radar data.

Rain Experiments

There are two SIR-C/X-SAR experiments planned to image rain over the Western Pacific Ocean, an area scientists call the "rainiest place on Earth."

Although radar can penetrate clouds, it is important to understand how rain can change conditions on the ground and thus, change the radar image. At the shorter wavelengths of X-band and C-band, rain may reduce the strength of the radar or scatter the signals significantly.

The rain experiments offer a unique challenge to the operation of the radar during flight. All the other experiments can be reasonably tied to a specific area, while the rain experiments only require that a "deep" rainstorm be in progress. Weather targets are transitory in both space and time and cannot be scheduled, so finding a good

target of opportunity presents challenges. Scientists chose the Western Pacific because there is a high probability that it will be raining there when the Shuttle passes over it.

SIR-C Instrument

Built by NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif., and the Ball Communications Systems Division, SIR-C is a two-frequency radar including L-band (23-cm wavelength) and C-band (6-cm wavelength).

SIR-C represents a technological advance from previous imaging radar. Just as color pictures contain more information than do black and white pictures, SIR-C's multi-frequency, multi-polarization radar imagery provide more information about Earth's surface features than do single-frequency, single-polarization images.

SIR-C is the first spaceborne radar with the ability to transmit and receive horizontally (H) and vertically (V) polarized waves at both frequencies. Polarization describes how the radar wave travels in space. The interaction between the transmitted waves and the Earth's surface determines the polarization of the waves received by the antenna. For example, when data are acquired with HH (horizontal-horizontal) polarization, the wave is transmitted from the antenna in the horizontal plane and the antenna receives the backscattered radiation in the horizontal plane. The other polarizations are HV (horizontally transmitted, vertically received), VH (vertical-horizontal) and VV (vertical-vertical).

Multi-polarization data are particularly useful to scientists studying vegetation because the data allow them to see different types of crops and to estimate the volume of trees contained under the canopy of a forest. The multi-frequency, multi-polarization capability creates a new and more powerful tool for studying the environment.

Unlike previous SIR missions, the SIR-C radar beam is formed from hundreds of small transmitters embedded in the surface of the radar antenna. By properly adjusting the energy from these transmitters, the beam can be electronically steered without physically moving the large radar antenna. This feature, combined with maneuvers by the Shuttle, will allow images to be acquired from many directions, allowing the study of how surface features' reflections characteristically vary as the angle between the surface and the incident radar wave (the incident angle) varies.

The SIR-C antenna is the most massive piece of flight hardware ever built at JPL. Its mass is 23,100 pounds (10,500 kilograms) and it measures approximately 39 feet by 13 feet (12 meters by 4 meters). The instrument is composed of several subsystems: the antenna array, transmitter, receivers, data-handling subsystem and the ground processor. The antenna consists of three leaves, each divided into four subpanels.

X-SAR Instrument

X-SAR was built by the Dornier and Alenia Spazio companies for the German Space Agency, Deutsche Agentur fuer Raumfahrtangelegenheiten (DARA), and the

SPACEBORNE IMAGING RADAR-C (SIR-C) X-BAND SYNTHETIC APERTURE RADAR (X-SAR)

SYSTEM CHARACTERISTICS

	L	C	X
FREQUENCY	1.25 GHz	5.3 GHz	9.6 GHz
WAVELENGTH	24 cm	5.7 cm	3.1 cm
POLARIZATION	HH (L, C)	VV (L, C, X)	VH (L, C)
LOOK ANGLE	15-55 deg		

IMAGE CHARACTERISTICS

SWATH WIDTH	15-60 km	
AZIMUTH RESOLUTION	25 m	
RANGE RESOLUTION	60-15 m (Low Resolution),	30-10 m (High Resolution)
NUMBER OF LOOKS	4	
CALIBRATION GOALS	±1 dB Relative, ±3 dB Absolute	

INSTRUMENT CHARACTERISTICS

PEAK POWER	3.5 kW	2.2 kW	3.3 kW
ANTENNA DIMENSIONS	12 x 2.95 m	12 x 0.75 m	12 x 0.40 m
BANDWIDTH	10 or 20 MHz		
DATA RATE	45 Mbps/Channel		

ORBIT CHARACTERISTICS

ALTITUDE	215 km
INCLINATION	57 deg

MISSION

DURATION	8-10 days
LAUNCH VEHICLE	Shuttle



Italian space agency, Agenzia Spaziale Italiana (ASI), respectively. The scientific processing progress is managed by DARA. It is a single-polarization radar operating at X-band (3-cm wavelength).

X-SAR uses a slotted-waveguide antenna, which is finely tuned to produce a narrow, pencil-thin beam of energy. The X-SAR antenna is mounted on a supporting structure that is tilted mechanically to align the X-band beam with the L-band and C-band beams. X-SAR will provide VV polarization images.

The SIR-C and X-SAR instruments can be operated individually or in conjunction. The width of the ground swath varies from 9 to 56 miles (15 to 90 kilometers), depending on the orientation of the antenna beams. The resolution of the radars — the size of the smallest objects they can distinguish — can be varied from 33 to 656 feet (10 to 200 meters).

Previous Radar Missions

Since the late 1970s a variety of NASA satellite missions have used imaging radar to study Earth and its planetary neighbors. Perhaps the most familiar example of NASA's success using imaging radar is the Magellan mission to Venus. Magellan's radar pierced the dense clouds covering Venus to map the entire surface of the planet, revealing a world that had previously been hidden to humans.

SIR-C is the latest technological advance in a series of Earth-observing imaging radar missions that began in June 1978 with the launch of Seasat, an L-band SAR and continued with SIR-A in November 1981. Both of those radars observed the Earth from fixed angles. SIR-B was flown aboard the Space Shuttle in October 1984.

The X-SAR antenna is a follow-on to Germany's Microwave Remote Sensing Experiment (MRSE), flown aboard the first Shuttle Spacelab mission in 1983.

Technological Advances in NASA Earth-Observing Radars

Mission	Date	Available Angle of Incidence	Frequencies	Available Polarizations
Seasat	June 1978	23 degrees	L-band	HH
SIR-A	Nov. 1981	50 degrees	L-band	HH
SIR-B	Oct. 1984	Variable	L-band	HH
SIR-C	April 1994	15-55 degrees	L-band	HH
	Aug. 1994		C-band	HV
				VH
				HH

Data Collection, Processing and Image Releases

SIR-C/X-SAR is designed to collect 50 hours of data, covering approximately 18 million square miles (50 million square kilometers). All data will be stored onboard the Shuttle using a new generation of high-density, digital, rotary-head tape recorders. There will be 180 digital tape cartridges (similar to VCR tape cassettes) carried aboard the Shuttle to record the data. Portions of data also will be downlinked to the ground via NASA's Tracking and Data Relay Satellite System.

Ultimately, the mission will return 32 terabits (32 trillion bits) of data, the equivalent of 20,000 encyclopedia volumes. To think of it another way, the radars together can produce 225 million bits of data per second, or the equivalent of 45 simultaneously operating television stations.

The raw data will be processed into images using digital SAR processors at JPL (Pasadena, Calif.) DARA/DLR (Oberpfaffenhofen, Germany) and ASI/CGS (Matera, Italy). Historically, processing SAR data has required a great deal of computer time on special-purpose computer systems. SIR-C/X-SAR scientists will benefit, however, from rapid advances in computer technology that make it possible to process the images with a standard super mini-class computer.

Even with these advances, it still will take 5 months to produce a complete set of survey images from the large volume of data acquired. Detailed processing will take another 9 months to complete. Data will be exchanged among Italy, Germany and the United States to meet the needs of the science investigators.

NASA, DARA and ASI will attempt to release some radar images to the press during the Shuttle flight. If this proves feasible, the images will be processed at JPL and sent electronically via Internet to the Johnson Space Center, where the image will be released on NASA Select Television. Hard copy prints will be released simultaneously to the wire services at JPL. In Germany, the images will be processed in high resolution by DLR.

Science Team

An international team of 49 science investigators and three associates will conduct the SIR-C/X-SAR experiments. Thirteen nations are represented: Australia, Austria, Brazil, Canada, China, the United Kingdom, France, Germany, Italy, Japan, Mexico, Saudi Arabia and the United States.

Dr. Diane Evans of the JPL is the U.S. Project Scientist. Dr. Herwig Ottl of DLR is the German Project Scientist and Prof. Mario Calamia of the University of Florence is the Italian Project Scientist. Dr. Miriam Baltuck of NASA Headquarters is the Program Scientist.

Management

The SIR-C mission is managed by JPL for NASA Headquarters Office of Mission to Planet Earth. Michael Sander is the JPL Project Manager. Richard Monson of the Office of Mission to Planet Earth is the SIR-C Program Manager; Jim McGuire of NASA Headquarters is the SRL Program Manager.

X-SAR is managed by the Joint Project Office located near Bonn, Germany. Dr. Manfred Wahl of DARA is the Project Manager and Dr. Paolo Ammendola of ASI is the Deputy Project Manager.

MEASUREMENT OF AIR POLLUTION FROM SATELLITE (MAPS)

The MAPS experiment measures the global distribution of carbon monoxide in the troposphere, or lower atmosphere. Measurements of carbon monoxide, an important element in several chemical cycles, provide scientists with indications of how well the atmosphere can clean itself of "greenhouse gases," chemicals that can increase the atmosphere's temperature.

Why do we measure carbon monoxide?

Today, humanity's technological and agricultural activities are generating carbon monoxide in large and increasing quantities. This colorless, odorless gas is produced whenever most fuels are burned, most abundantly by automobile engines and as a result of the burning forests and grasslands.

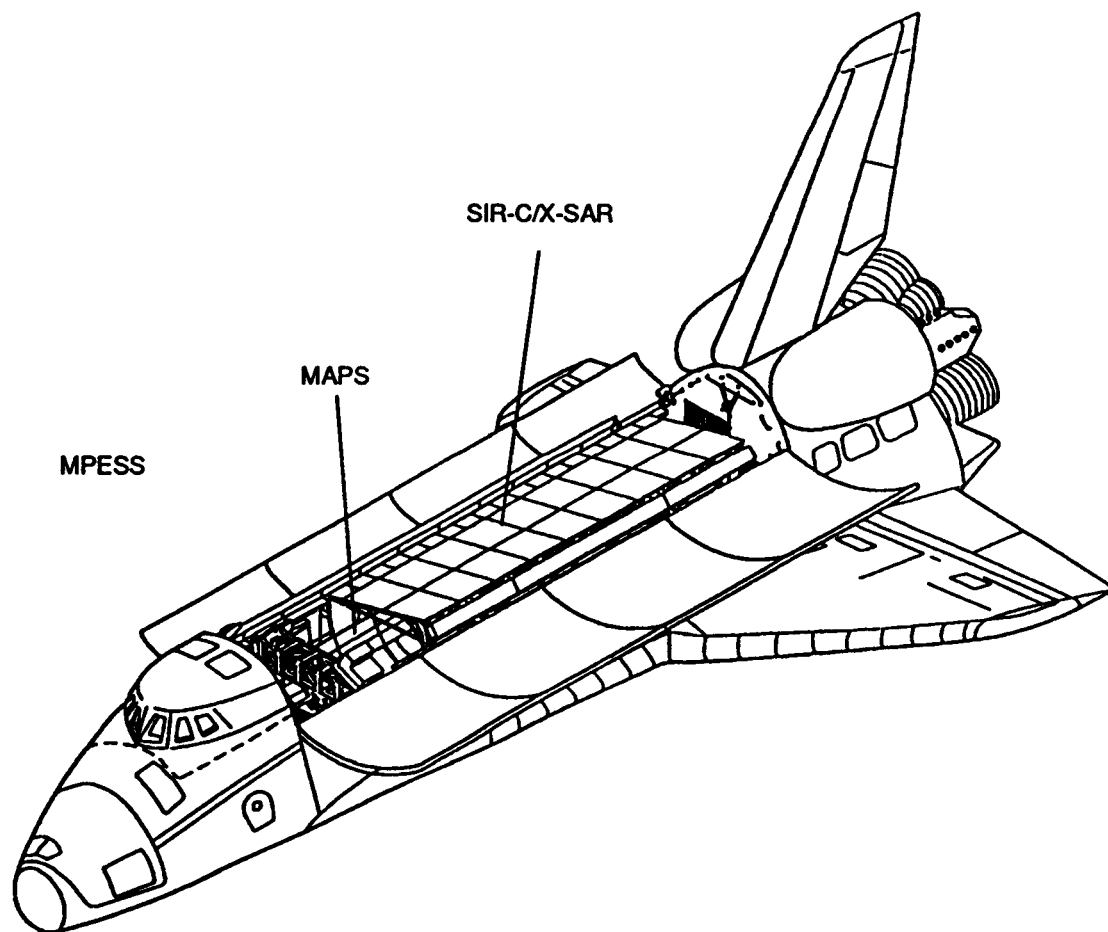
Once carbon monoxide enters the atmosphere, it is transported over long distances and ultimately, is converted to carbon dioxide by a chemical called the hydroxyl, "OH," radical. The OH radical is the key participant in the breakdown and removal of greenhouse gases such as methane, which in turn is important in the chemistry of stratospheric ozone.

It appears that as carbon monoxide emissions increase and react with the OH radical, the amount of OH available to convert other gases in the atmosphere will decrease. If concentrations of OH are reduced, the breakdown and removal of greenhouse gases also will be reduced. Reduction of the OH radical thus will have long-term influence on stratospheric ozone, the destruction of greenhouse gases and potentially, on climate.

The actual size of sources of carbon monoxide, the way that they change over the course of the year and the patterns of the movement of the gas away from the sources are not now well known. The MAPS data are very useful in the study of these factors.

Data collection and processing

MAPS' primary goal is to measure the distribution of carbon monoxide in the atmosphere between the altitudes of 2 and 10 miles (4 and 15 kilometers). The data



are recorded on a tape recorder and transmitted directly to the ground using the Space Shuttle telemetry system. The signals will be processed at the Payload Operations Control Center to produce "quick look" maps of the carbon monoxide distribution. These "quick look" data will be used to plan the exact periods of data acquisition during the flight.

Following the flight, the recorded data will be processed using more refined techniques, and the data will be combined with ground- and aircraft-based data obtained by collaborating scientists from several countries. This will present a more detailed description of the distribution of the gas than can be obtained by any single technique.

Results from previous flights

The MAPS instrument first flew on the second flight of the Space Shuttle in November 1981. It obtained 12 hours of data that showed that most of the carbon monoxide in the atmosphere at the altitudes measured by MAPS was located in the Earth's tropical regions rather than in the Northern Hemisphere. Further, the amount of carbon monoxide changed much more rapidly east to west than had been expected. The results implied that forest and grassland burning in the tropics is more important as a source of carbon monoxide than had been thought.

The MAPS experiment again flew on the Space Shuttle during early October 1984. About 80 hours of data were obtained. That clearly confirmed that burning in South America and southern Africa was a major source of carbon monoxide.

Because of MAPS' previous flights on board the Space Shuttle, scientists now know that carbon monoxide concentrations in the troposphere are highly variable around the planet, and that widespread burning in the South American Amazon region and the African savannahs is a major global source of carbon monoxide in the troposphere.

MAPS instrument

The MAPS hardware consists of an optical box, an electronics box, a tape recorder and a camera, all mounted to a single base plate. This assembly is mounted to a Multi-purpose Experiment Support Structure near the forward end of the cargo bay. The instrument is about 36 inches long, 30 inches wide and 23 inches high. It weighs 203 pounds and consumes about 125 watts of electrical power.

The Program Manager is Louis Caudill, and Dr. Michael Kurylo is the Program Scientist, both at NASA Headquarters, Washington, D.C. The Principal Investigator for MAPS is Dr. Henry G. Reichle, Jr., and the Project Manager is John Fedors, both from the NASA Langley Research Center. The experiment is guided by a science team whose members are Dr. V. Connors, NASA Langley Research Center; W. Hesketh, SpaceTec, Inc.; Dr. P. Kasibhatla, Georgia Institute of Technology; Dr. V. Kirchhoff, INPE, Brazil; Dr. J. Logan, Harvard University; Dr. R. Newell, Massachusetts Institute of Technology; Dr. R. Nicholls, York University, Canada; Dr. L. Peters, Virginia

Polytechnic Institute and State University; Dr. W. Seiler, IFU, Germany; and H. Wallio, NASA Langley Research Center.

GET AWAY SPECIAL PAYLOADS

The Get Away Special (GAS) project is managed by the Goddard Space Flight Center (GSFC), Greenbelt, Md. NASA began flying these small self-contained payloads in 1982. The project gives the average person a chance to perform experiments in space on a Shuttle mission. Students, individuals and people from the private industry have taken advantage of this unique project. In February, STS-60 flew the 100th GAS payload. This milestone demonstrates that the program is still viable and thriving. Space is available for upcoming flights, and GAS presents an educational opportunity for students.

There are three GAS payloads on this flight: G-203, New Mexico State University; G-300, Matra Marconi Space; and G-458, The Society of Japanese Aerospace Companies, Inc. Following is a brief description of each.

G-203

Customer: New Mexico State University, Las Cruces, N.M.

Customer: Dr. Harold Daw

NASA Technical Manager: Charlie Knapp

The purpose of this experiment is to examine the freezing and crystallization process of water in spaceflight. Experimenters will study growth patterns of ice crystals in a microgravity condition. Growth pattern data will be captured by a video recorder. A vapor valve is opened to initiate the experiment allowing the water vapor in the chamber to be adsorbed rapidly (the adhesion of extremely thin layers of molecules to the surface of solid bodies or liquids with which they are in contact) into the pores of the dry zeolite contained in the chamber. The rapid adsorption of the water vapor causes the water temperature to drop to a point of freezing. Other water freezing experiments have flown on Shuttle flights but this experiment is unique in its freezing technique and is predicted to produce very different ice crystal growth patterns.

G-300

Customer: Matra Marconi Space, Paris, France

Customer: Daniel Kaplan

NASA Technical Manager: Rick Scott

The objective of this experiment is to explore thermal conductivity measurements on liquids in microgravity. Measurements will be performed on three silicone oils having different viscosities. The experimenters will use a modified "hot plate" method with a simplified guard ring to reduce heat losses. The experimental cells are assembled in three tandems: Each tandem includes two cells filled with the same liquid but of different thicknesses. The convective motions are expected to be strongly reduced in orbit unless large gravitational variations occur.

The three modes of heat transfer in liquids (conduction, radiation and convection) are inherently linked in a 1g environment and are empirically difficult to perform on

fluids because of thermal motions induced by convection. In orbit, assuming a near-zero gravity, the convection, due to buoyancy, must disappear and the accuracy of the thermal conductivity data will be improved, especially with low viscosity liquids. Furthermore, the convection effects can be determined by comparing results from spaceflight and on Earth.

This is the first GAS payload from France. It had flown previously on STS-47 but an unforeseen event caused the experiment to be turned on before flight.

G-458

Customer: The Society of Japanese Aerospace Companies, Inc.,
Tokyo, Japan

Customer: Dr. S. Hosaka

NASA Technical Manager: Charlie Knapp

The objective of this experiment is to determine whether small fruiting bodies can be obtained in microgravity. The information will be obtained by taking a culture of *Dictyosotellium Discoideum* in microgravity. The cellular slime mold is one of the most interesting organisms, due to its characteristic properties. It assumes unicellular, multicellular, plant-like and animal-like properties during its life cycle. Still, it is a very simple organism because it is composed of only two kinds of cells, even when it is fully developed. Because of this, its response to altered gravity can be regarded as a typical representative of gravi-response of organisms.

The cellular slime mold is a small organism with a body length of several millimeters and is rather resistant to a wide variety of environmental conditions. Ground experiments proved that the height of fruiting bodies of *Dictyosotellium Discoideum* was gravity-dependent. The height decreased as the gravity decreased. This contradicts the prediction that microgravity favors the growth of organisms resulting in larger height. It is believed that this experiment will conclude that in some cases more gravity is favorable and microgravity is unfavorable for vertical growth.

CONSORTIUM FOR MATERIALS DEVELOPMENT IN SPACE COMPLEX AUTONOMOUS PAYLOAD

The Consortium for Materials Development in Space - Complex Autonomous Payload (CONCAP-IV) will be carried in Get Away Special hardware in Endeavour's cargo bay. CONCAP-IV is contained in a 5-cubic-foot GAS canister mounted to an adapter beam. The Autonomous Payload Control System allows a crew member to control the payload with a small, hand-held controller.

CONCAP-IV produces crystals and thin films through physical vapor transportation. Non-Linear Optical (NLO) organic materials are used in the CONCAP experimentation. The payload takes advantage of the free-fall environment of low-Earth orbit to grow the NLO crystals. It is expected that the lack of significant gravity-driven convection will result in more highly ordered films and crystals.

CONCAP-IV was developed by the University of Alabama-Huntsville.

VISUAL FUNCTION TESTER-4

The Visual Function Tester-4 (VFT-4) is designed to measure near and far points of clear vision as well as the ability to change focus within the range of clear vision. VFT-4 will provide data to evaluate on orbit refractive and accommodative changes in vision over a period of several days.

The VFT-4 payload consists of the experiment unit, a cable connecting VFT-4 to a computer serial port, 2 self-booting floppy disks containing a software program and serving as a data storage medium, a payload and general support computer with power and data cables and a standard 28-volt power cable.

Prelaunch, three sessions are required with crew as test subjects. The sessions occur at L-14 days, L-7 days and as close to launch as possible. On orbit, VFT-4 is unstowed by the crew for test sessions lasting up to 30 minutes each. The first test session is early in the payload operation period. Subsequent tests are separated by 24 hours. Preferably, these tests are conducted soon after post-sleep. The VFT-4 hardware will be restowed between sessions. Crew members who participate in VFT-4 sessions on orbit will be retested post-flight.

VFT-4 is operated by NASA and the U. S. Air Force Space and Missile Systems Center.

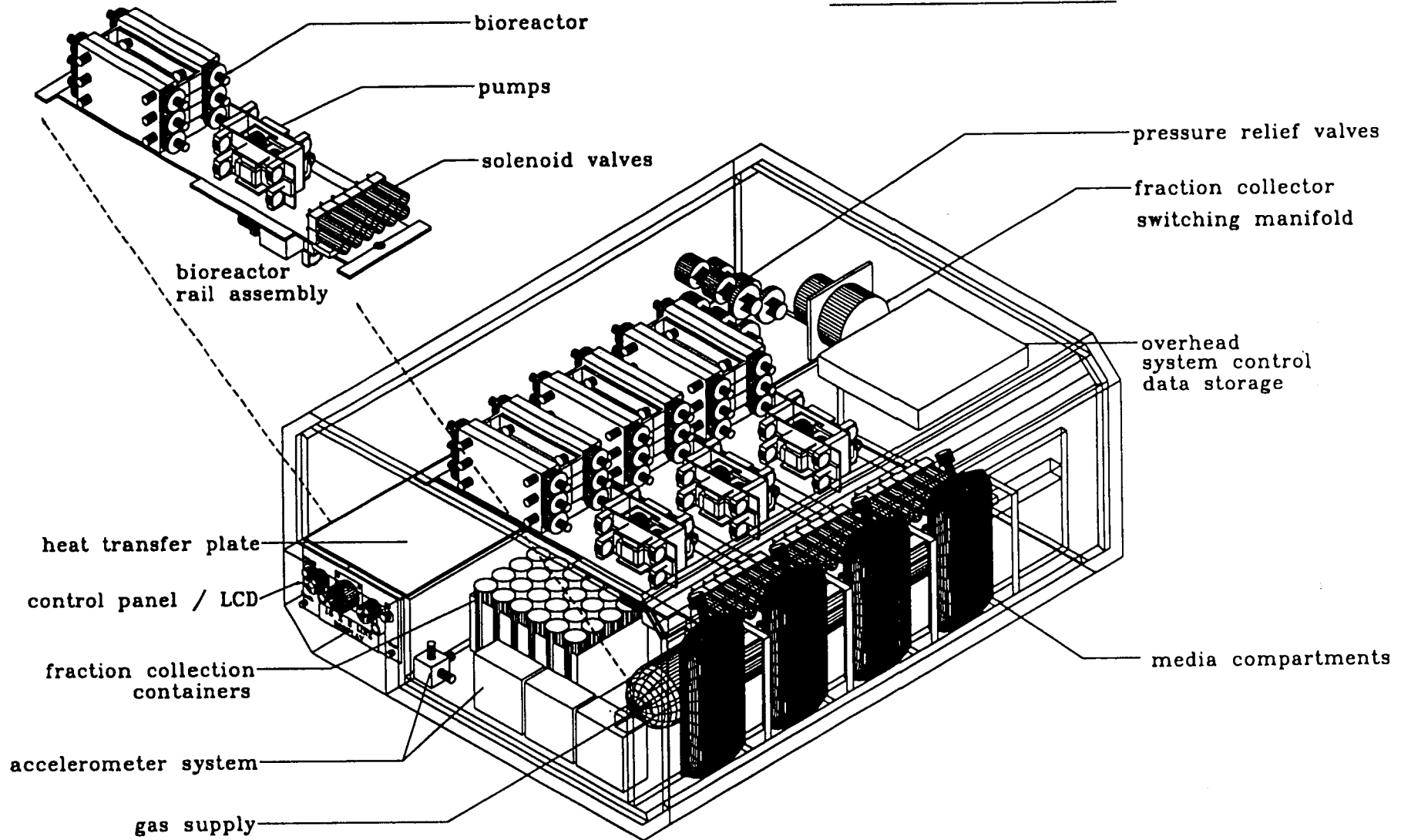
SPACE TISSUE LOSS-4/NATIONAL INSTITUTES OF HEALTH-1

STS-59 will fly the first cooperative initiative with the National Institutes of Health (NIH), sponsored by NASA's Office of Life and Microgravity Sciences and Applications Small Payloads Program. The joint initiative in cell biology will use a special cell culture system developed by the Walter Reed Army Institute of Research, Washington, D.C. The system, known as Space Tissue Loss-4 (STL-4), is fully automated and provides fluid replenishment, oxygen/carbon dioxide and temperature controls to provide for cell growth in microgravity. The cells will be analyzed post-flight. The experiments on this first NIH/NASA cooperative flight will examine the effects of microgravity on muscle and bone cells. Preliminary flight tests using this cell culture system have indicated there may be effects in the rate in which new muscle and bone cells are formed in microgravity. This research will help understand what is happening on the cellular level to astronauts who suffer from bone loss and muscle deterioration in spaceflight. This research also should contribute to understanding of the mechanisms involved in bone loss and muscle atrophy on Earth. The STL-4 experiments are being managed by the Ames Research Center, Mountain View, Calif.

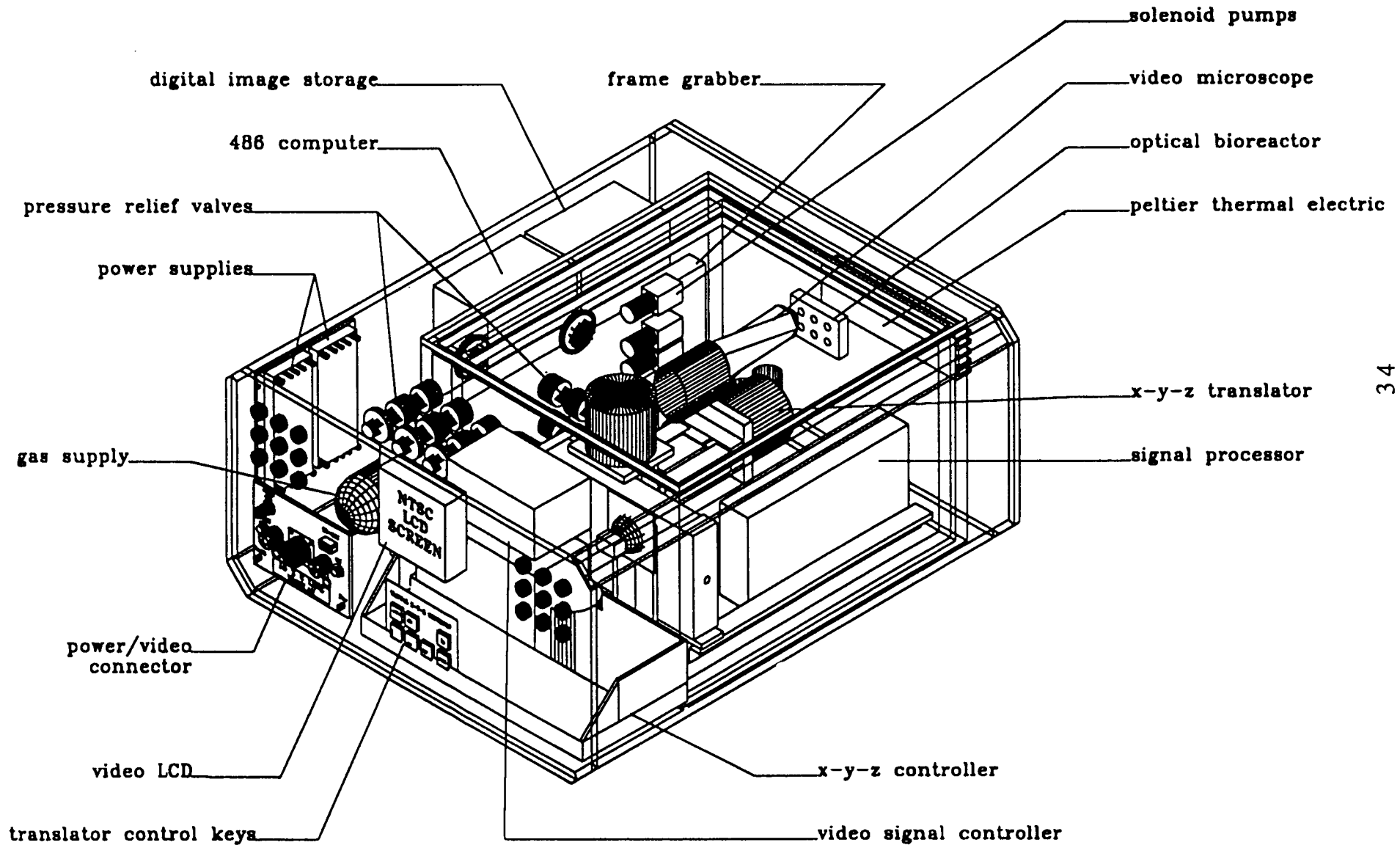
Space Tissue Loss - 5

An advanced cell culture device known as STL-5 will be flown on STS-59. This is the first flight test of this hardware developed by the Walter Reed Army Institute of Research, Washington, D.C. This new system includes a video-microscope that will allow scientists on the ground to see real-time video images of their experiments in space. The instrument is designed to be controlled by either astronauts in space or

STL-4 MODULE



STL- 5 MODULE



individuals on the ground. This telescience from the middeck opens up the possibility for scientists to monitor and control their space experiments from the ground. The objective of this flight is to test the operation of the equipment in microgravity. Fish eggs will be used to test the imaging capability of the system.

Shuttle Amateur Radio Experiment (SAREX)

Students in the United States, Finland and Australia will have a chance to speak via amateur radio with astronauts aboard the Space Shuttle Endeavour during STS-59. Ground-based amateur radio operators ("hams") will be able to contact the Shuttle through automated computer-to-computer amateur (packet) radio links. There also will be voice contacts with the general ham community as time permits.

Shuttle mission specialists Linda Godwin (call sign N5RAX) and Jay Apt (N5QWL) will talk with students in 9 schools in the United States, Finland and Australia using "ham radio."

Students in the following schools will have the opportunity to talk directly with orbiting astronauts for approximately 4 to 8 minutes:

- * Ealy Elementary School, West Bloomfield, Mich. (W8JXU)
- * Kanawha Elementary School, Davisville, W.V. (KD8YY)
- * Alcatel Amateur Radio Associates and Circle Ten Council, BSA, Richardson, Texas (K2BSA/5)
- * Anthony Elementary School, Anthony, Kan. (KB0HH)
- * St. Bernard High School, Playa Del Rey, Calif. (AB6UI)
- * Country Club School, San Ramon, Calif. (KE6YD)
- * Deep Creek Middle School, Baltimore, Md. (WA3Z)
- * Paltamo Senior High School, Paltamo, Finland (OH8AK)
- * Ogilvie School, Western Australia (VK6IU)

The radio contacts are part of the SAREX (Shuttle Amateur Radio Experiment) project, a joint effort by NASA, the American Radio Relay League (ARRL), and the Radio Amateur Satellite Corporation (AMSAT).

The project, which has flown on 12 previous Shuttle missions, is designed to encourage public participation in the space program and support the conduct of educational initiatives through a program to demonstrate the effectiveness of communications between the Shuttle and low-cost ground stations using amateur radio voice and digital techniques.

Information about orbital elements, contact times, frequencies and crew operating schedules will be available during the mission from NASA, ARRL (Steve Mansfield, 203/666-1541) and AMSAT (Frank Bauer, 301/ 286-8496). AMSAT will provide information bulletins for interested parties on INTERNET and amateur packet radio.

The ham radio club at the Johnson Space Center, (W5RRR), will be operating on amateur short wave frequencies, and the ARRL station (W1AW) will include SAREX information in its regular voice and teletype bulletins.

There will be a SAREX information desk during the mission in the Johnson Space Center newsroom. Mission information will be available on the computer bulletin board (BBS). To reach the bulletin board, use JSC BBS (8 N 1 1200 baud): dial 713-483-2500, then type 62511.

The amateur radio station at the Goddard Space Flight Center, (WA3NAN), will operate around the clock during the mission, providing SAREX information and retransmitting live Shuttle air-to-ground audio.

STS-59 SAREX Frequencies

Routine SAREX transmissions from the Space Shuttle may be monitored on a worldwide downlink frequency of 145.55 MHz.

The voice uplink frequencies are (except Europe):

144.91 MHz
144.93
144.95
144.97
144.99

The voice uplink frequencies for Europe only are:

144.70
144.75
144.80

Note: The astronauts will not favor any one of the above frequencies. Therefore, the ability to talk with an astronaut depends on selecting one of the above frequencies chosen by the astronaut.

The worldwide amateur packet frequencies are:

Packet downlink	145.55 MHz
Packet uplink	144.49 MHz

The Goddard Space Flight Center amateur radio club planned HF operating frequencies:

3.860 MHz	7.185 MHz
14.295	21.395
28.650	

TOUGHENED UNI-PIECE FIBROUS INSULATION

NASA will test an improved thermal protection tile on the STS-59 mission. Known as Toughened Uni-Piece Fibrous Insulation (TUFI), the new tile material is an advanced version of the material that protects the Space Shuttles from the intense heat that builds up as they re-enter Earth's atmosphere. The tiles were processed by Rockwell International, Downey, Calif., which built and maintains the orbiters. TUFI was developed at NASA's Ames Research Center, Mountain View, Calif.

During preparations for this mission, Rockwell technicians at Kennedy Space Center placed several TUFI tiles on Endeavour's base heat shield, between the three main engines. At the end of the mission, NASA and Rockwell technicians will examine the tiles and compare the damage with that seen on previous missions using the originally designed tile material.

The current tiles are a rigid glass fiber composite with a thin, fully dense glass coating that sits on top. When it gets hit with a rock or other debris, the coating cracks or chips. This requires either patching or replacement, depending on the extent of damage.

Because TUFI permeates the pores nearer the surface of the insulation material, providing reinforcement to the composite surface, it is less subject to impact damage. The porous surface also stops cracks from spreading, which limits damage to the tile. Because there is less damage, repair is easier and faster, and fewer tiles should need replacement. This should result in lower repair costs.

TUFI has been certified for six Shuttle flights, on all four orbiters. If the tests are successful, TUFI may be used to replace tiles in specific, limited areas of the orbiter susceptible to significant impact damage. These might include the base heat shield between the engines, near the landing gear doors and near the thrusters used for orbital maneuvering.

STS-59 CREW BIOGRAPHIES

Sidney M. Gutierrez, 42, Col., USAF, will be commander (CDR) of STS-59. He was selected to be an astronaut in 1984 and will be making his second flight aboard the Space Shuttle.

Gutierrez was born in Albuquerque, N.M. He graduated from Valley High School, Albuquerque, in 1969; received a bachelor's degree in aeronautical engineering from the Air Force Academy in 1973; and received a master's degree in management from Webster College in 1977.

Following graduation from the Air Force Academy, where he was a member of the National Championship USAFA Parachute Team and completed more than 550 jumps, Gutierrez completed pilot training at Laughlin Air Force Base, Del Rio, Tex. He then served as an instructor pilot in T-38 aircraft at Laughlin from 1975-77, and in 1978, was assigned to the 7th Tactical Fighter Squadron, Holloman Air Force Base, Alamogordo, N.M., flying the F-15 Eagle aircraft. Gutierrez attended the Air Force Test Pilot School in 1981, and after graduating, served as the primary test pilot for airframe and propulsion testing on the F-16 aircraft.

Gutierrez' first Shuttle flight was as pilot of STS-40, the first Spacelab Life Sciences flight, aboard Columbia in June 1991. Gutierrez has logged more than 218 hours in space and more than 4,000 hours in flying time in 30 different types of aircraft, sailplanes, rockets and balloons.

Kevin P. Chilton, 39, Col., USAF, will serve as pilot (PLT). He was selected to be an astronaut in 1988 and will be making his second space flight.

Chilton was born in Los Angeles, Calif. He graduated from St. Bernard High School, Playa del Rey, Calif., in 1972; received a bachelor's degree in engineering sciences from the Air Force Academy in 1976; and received a master's degree in mechanical engineering from Columbia University in 1977.

Chilton received his wings at Williams Air Force Base, Ariz., in 1978, and was assigned to the 15th Tactical Reconnaissance Squadron at Kadena Air Base, Japan, flying the RF4 Phantom II aircraft. In 1981, he was assigned to the 67th Tactical Fighter Squadron at Kadena Air Base flying the F-15 Eagle aircraft. Chilton attended the Air Force Squadron Officer School in 1982 and served as an F-15 weapons officer, instructor pilot and flight commander until 1984 at Holloman Air Force Base, N.M. He completed the Air Force Test Pilot School in 1984 and later served as weapons and systems test pilot in the F-15 and F-4.

Chilton's first space flight was as pilot of Endeavour's maiden flight on STS-49, a mission that repaired a stranded INTELSAT communications satellite, in May 1992. He has logged more than 213 hours in space.

Linda M. Godwin, 41, is payload commander and mission specialist 3 (MS-3). She is a member of the astronaut class of 1985 and will be making her second Shuttle flight.

Godwin was born in Cape Girardeau, Missouri, and considers Jackson, Mo., her hometown. She graduated from Jackson High School in 1970 and received a bachelor of science degree in mathematics and physics from Southeast Missouri State in 1974. In 1976 and 1980 she earned master of science and doctorate degrees in physics from the University of Missouri.

She joined NASA in 1980 working in the payload integration office of the Mission Operations Directorate. Before being selected an astronaut, Godwin served in Mission Control as a flight controller and payloads officer on several Shuttle missions.

Her first Shuttle mission was aboard Atlantis on the STS-37 mission in April 1991. The primary task of the crew during the flight was to deploy the Compton Gamma Ray Observatory and to evaluate translation techniques during two spacewalks. Godwin has logged more than 143 hours in space. She also has logged approximately 500 hours in light aircraft.

Jay Apt, 44, will be mission specialist 1 (MS-1) and the commander of the blue shift on STS-59. He was chosen to be an astronaut in 1985 and will be making his third Space Shuttle flight.

Apt was born in Springfield, Massachusetts, but considers Pittsburgh, Pennsylvania, his hometown. He graduated from Shady Side Academy in Pittsburgh in 1967; received a bachelor of arts degree in physics from Harvard College in 1971; and received a doctorate in physics from the Massachusetts Institute of Technology in 1976.

He joined NASA in 1980 and worked in the Earth and Space Sciences Division at the Jet Propulsion Laboratory, doing planetary research as part of the Pioneer Venus Orbiter Infrared team. In 1981, he became the manager of JPL's Table Mountain Observatory. He served as a flight controller and payloads officer in Mission Control from 1982 through 1985.

Apt flew on the Shuttle first as a mission specialist on Atlantis' eighth mission, STS-37 in April 1991, to deploy the Compton Gamma Ray Observatory. During that mission, he conducted two spacewalks to release a stuck antenna on the Compton Gamma Ray Observatory and to evaluate translation techniques for possible use during future spacewalks and spacecraft assembly in orbit.

His second flight, also as a mission specialist, was aboard Endeavour in September 1992. This mission was a cooperative effort between the U.S. and Japan to perform life sciences and materials processing experiments in the Spacelab pressurized module housed in the payload bay. He was the flight engineer and commanded the blue shift during the mission.

In addition to his two Shuttle missions totaling 334 hours, Apt has logged more than 3,000 hours in 25 different types of aircraft.

Michael R. "Rich" Clifford, 41, Lt. Col., USAF, is mission specialist 2 (MS-2). Selected as an astronaut in 1990, he will be making his second flight aboard the Space Shuttle.

Clifford was born in San Bernardino, Calif., but considers Ogden, Utah, his hometown. He graduated from Ben Lomond High School in Ogden in 1970. In 1974, Clifford received his bachelor of science degree from the U.S. Military Academy, West Point, N. Y. He earned a master of science degree in aerospace engineering in 1982 from the Georgia Institute of Technology.

After graduation from the Naval Test Pilot School in 1986, he was designated an experimental test pilot. He was assigned to the Johnson Space Center in 1987 as a military officer and served as a Space Shuttle vehicle integration engineer. He was involved in design certification and integration of the Shuttle crew escape system.

Clifford's first Shuttle mission aboard Discovery, STS-53, was a Department of Defense flight in December 1992 giving him more than 175 hours in space. He has logged more than 2,900 flying hours in a wide variety of fixed and rotary winged aircraft.

Thomas D. Jones, 39, will serve as mission specialist 4 (MS-4). He was selected to be a member of the astronaut corps in 1990 and will be making his first flight aboard the Space Shuttle.

Jones was born in Baltimore, Md. He graduated from Kenwood Senior High School, Essex, Md., in 1973. He received a bachelor of science degree in basic sciences from the U.S. Air Force Academy in Colorado Springs in 1977, and a doctorate in planetary science from the University of Arizona, Tucson, in 1988.

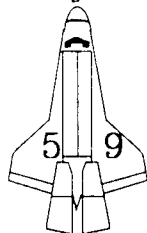
He served on active duty as an Air Force officer for six years flying strategic bombers at Carswell AFB, Texas. While serving as a pilot and commander of a B-52D Stratofortress, he led a combat crew of six, accumulating more than 2,000 hours of jet experience. He resigned his commission in 1983 with the rank of captain.

Prior to his selection as an astronaut, Jones was a program management engineer in the Office of Development and Engineering, CIA, and a senior scientist with Science Applications International Corp. (SAIC), Washington, D.C. At SAIC, his tasks included advanced program planning for the Solar System Exploration Division at NASA Headquarters, concentrating on future robotic missions to Mars, asteroids, and the outer solar system.

In addition to the STS-59 mission, Jones is training as the payload commander for the second Space Radar Laboratory mission (SRL-2) scheduled for launch in August 1994 (STS-68).

Upcoming Space Shuttle Flights

* George Diller



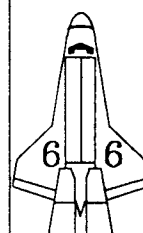
Endeavour

1994
Pad 39-A

Launch targeted for April. Mission includes Space Radar Lab-1. Inclination 57 degrees/138 st. miles. Nine days. Crew includes: Sidney M. Gutierrez; Kevin P. Chilton; Linda M. Godwin (PC); Thomas D. Jones; Jay Apt; Michael R. "Rich" Clifford.

Landing: KSC

* Lisa Malone



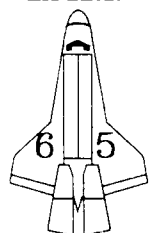
Atlantis

1994
Pad 39-A

Launch targeted for October. Payloads include Atlas-03, CRISTA-SPAS, SSBV/A-03. Inclination 57 degrees/185 st. miles. Ten days. Crew: Donald R. McMonagle; Curtis L. Brown; Ellen Ochoa (PC); Scott E. Parazynski; Joseph R. Tanner; Jean-Francois Clervoy.

Landing: KSC

* Lisa Malone



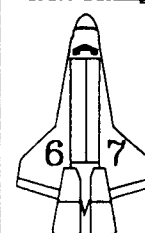
Columbia

1994
Pad 39-A

Launch targeted for July. Primary payload is International Microgravity Laboratory-2. Inclination 28.45 degrees/185 st. miles. 13 days. Robert D. Cabana; James D. Halsell Jr.; Richard J. Hieb; Leroy Chiao; Donald A. Thomas; Carl E. Walz; Chiaki Mukai.

Landing: KSC

* Bruce Buckingham



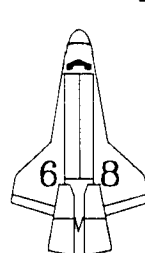
Columbia

1994
Pad 39-B

Launch targeted for December. Payload is ASTRO-02. Inclination 28.5 degrees/218 st. miles. Thirteen days. Crew: Stephen S. Oswald; William G. Gregory; Tamara E. Jernigan (PC); John M. Grunsfeld; Wendy B. Lawrence; Ronald A. Parise; Samuel T. Durrance.

Landing: KSC

* Bruce Buckingham



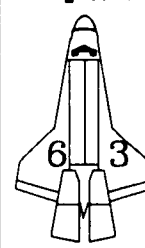
Endeavour

1994
Pad 39-A

Launch targeted for August. Payloads include Space Radar Laboratory-02. Inclination 57 degrees/138 st. miles. Nine days. Crew: Michael A. Baker; Terrence W. Wilcutt; Thomas D. Jones (PC); Steven L. Smith; Peter J. K. Wisoff; Daniel W. Bursch.

Landing: KSC

* George Diller



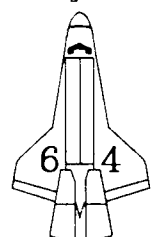
Discovery

1995
Pad 39-A

Launch targeted for January. Payloads include Spacehab-3, Spartan-204 and Oderacs-02. Inclination 51.6 degrees/195 st. miles. Eight days. Crew: James D. Wetherbee; Eileen M. Collins; C. Michael Foale; Janice E. Voss; Bernard A. Harris Jr.; Vladimir G. Titov. (Mir rendezvous mission).

Landing: KSC

* George Diller



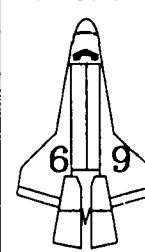
Discovery

1994
Pad 39-B

Launch targeted for September. Payloads include Lidar In-space Technology Experiment(LITE). Inclination 57 degrees/161 st. miles. Nine days. Crew: Richard N. Richards; L. Blaine Hammond Jr.; Carl J. Meade; Mark C. Lee; Susan J. Helms.

Landing: KSC

* Lisa Malone



Endeavour

1995
Pad 39-B

Launch targeted for March. Payloads include Wakesield Facility-02; OAST. Inclination 28.45 degrees/218 st. miles. Ten days. Crew: James Voss, Payload Commander. Remainder of five-member crew TBD.

Landing: KSC

SOME NOTES ON THIS SCHEDULE: This is an unofficial Space Shuttle launch schedule covering the period from April 1994 through March 1995. Crew listings name commanders first, then pilots, then mission and payload specialists. This flight listing is based on April 1993 Mixed Fleet Manifest. This graph is prepared by the Kennedy Space Center Public Information Office and is dated March 4, 1994. Abbreviations used include: EPD = Earliest Possible Date. TBD = To Be Determined. * = Public Affairs Commentator. PC = Payload Commander. Official launch dates are set at Flight Readiness Review.

SHUTTLE FLIGHTS AS OF MARCH 1994

61 TOTAL FLIGHTS OF THE SHUTTLE SYSTEM -- 36 SINCE RETURN TO FLIGHT

<div> <div>STS 51-L</div> <div>01/28/86</div> </div> <div> <div>STS 51-A</div> <div>10/30/85 - 11/06/85</div> </div> <div> <div>STS 51-F</div> <div>07/29/85 - 08/06/85</div> </div> <div> <div>STS 51-B</div> <div>04/29/85 - 05/6/85</div> </div> <div> <div>STS 41-G</div> <div>10/5/84 - 10/13/84</div> </div> <div> <div>STS 41-C</div> <div>04/06/84 - 04/13/84</div> </div> <div> <div>STS 41-B</div> <div>02/03/84 - 02/11/84</div> </div> <div> <div>STS-8</div> <div>08/30/83 - 09/05/83</div> </div> <div> <div>STS-7</div> <div>06/18/83 - 06/24/83</div> </div> <div> <div>STS-6</div> <div>04/04/83 - 04/09/83</div> </div>	<div> <div>STS-62</div> <div>3/4/94 - 3/--/94*</div> </div> <div> <div>STS-58</div> <div>10/18/93 - 11/01/93</div> </div> <div> <div>STS-55</div> <div>04/26/93 - 05/06/93</div> </div> <div> <div>STS-52</div> <div>10/22/92 - 11/1/92</div> </div> <div> <div>STS-50</div> <div>06/25/92 - 07/09/92</div> </div> <div> <div>STS-40</div> <div>06/05/91 - 06/14/91</div> </div> <div> <div>STS-35</div> <div>12/02/90 - 12/10/90</div> </div> <div> <div>STS-32</div> <div>01/09/90 - 01/20/90</div> </div> <div> <div>STS-28</div> <div>08/08/89 - 08/13/89</div> </div> <div> <div>STS 61-C</div> <div>01/12/86 - 01/18/86</div> </div> <div> <div>STS-9</div> <div>11/28/83 - 12/08/83</div> </div> <div> <div>STS-5</div> <div>11/11/82 - 11/16/82</div> </div> <div> <div>STS-4</div> <div>06/27/82 - 07/04/82</div> </div> <div> <div>STS-3</div> <div>03/22/82 - 03/30/82</div> </div> <div> <div>STS-2</div> <div>11/12/81 - 11/14/81</div> </div> <div> <div>STS-1</div> <div>04/12/81 - 04/14/81</div> </div>	<div> <div>STS-60</div> <div>02/03/94 - 02/11/94</div> </div> <div> <div>STS-51</div> <div>09/12/93 - 09/22/93</div> </div> <div> <div>STS-56</div> <div>04/08/93 - 04/17/93</div> </div> <div> <div>STS-53</div> <div>12/2/92 - 12/9/92</div> </div> <div> <div>STS-42</div> <div>01/22/92 - 01/30/92</div> </div> <div> <div>STS-48</div> <div>09/12/91 - 09/18/91</div> </div> <div> <div>STS-39</div> <div>04/28/91 - 05/06/91</div> </div> <div> <div>STS-41</div> <div>10/06/90 - 10/10/90</div> </div> <div> <div>STS-31</div> <div>04/24/90 - 04/29/90</div> </div> <div> <div>STS-33</div> <div>11/22/89 - 11/27/89</div> </div> <div> <div>STS-29</div> <div>03/13/89 - 03/18/89</div> </div> <div> <div>STS-26</div> <div>09/29/88 - 10/03/88</div> </div> <div> <div>STS 51-J</div> <div>08/27/85 - 09/03/85</div> </div> <div> <div>51-G</div> <div>06/17/85 - 06/24/85</div> </div> <div> <div>51-D</div> <div>04/12/85 - 04/19/85</div> </div> <div> <div>STS 51-C</div> <div>01/24/85 - 01/27/85</div> </div> <div> <div>STS 51-A</div> <div>11/08/84 - 11/16/84</div> </div> <div> <div>STS 41-D</div> <div>08/30/84 - 09/04/84</div> </div>	<div> <div>STS-46</div> <div>7/31/92 - 8/8/92</div> </div> <div> <div>STS-45</div> <div>03/24/92 - 04/02/92</div> </div> <div> <div>STS-44</div> <div>11/24/91 - 12/01/91</div> </div> <div> <div>STS-43</div> <div>08/02/91 - 08/11/91</div> </div> <div> <div>STS-37</div> <div>04/05/91 - 04/11/91</div> </div> <div> <div>STS-38</div> <div>11/15/90 - 11/20/90</div> </div> <div> <div>STS-36</div> <div>02/28/90 - 03/04/90</div> </div> <div> <div>STS-34</div> <div>10/18/89 - 10/23/89</div> </div> <div> <div>STS-30</div> <div>05/04/89 - 05/08/89</div> </div> <div> <div>STS-27</div> <div>12/02/88 - 12/06/88</div> </div> <div> <div>STS 61-B</div> <div>11/26/85 - 12/03/85</div> </div> <div> <div>STS 51-J</div> <div>10/03/85 - 10/07/85</div> </div>	<div> <div>STS-61</div> <div>12/2/93 - 12/13/93</div> </div> <div> <div>STS-57</div> <div>6/21/93 - 7/1/93</div> </div> <div> <div>STS-54</div> <div>01/13/93 - 01/19/93</div> </div> <div> <div>STS-47</div> <div>09/12/92 - 09/20/92</div> </div> <div> <div>STS-49</div> <div>05/07/92 - 05/16/92</div> </div>
<div>OV-099</div> <div>Challenger</div> <div>(10 flights)</div>	<div>OV-102</div> <div>Columbia</div> <div>(16 flights)</div>	<div>OV-103</div> <div>Discovery</div> <div>(18 flights)</div>	<div>OV-104</div> <div>Atlantis</div> <div>(12 flights)</div>	<div>OV-105</div> <div>Endeavour</div> <div>(5 flights)</div>

* Mission still in progress at press time



Drucella Andersen
Headquarters, Washington, D.C.
(Phone: 202/358-4733)

For Release

March 9, 1994

H. Keith Henry
Langley Research Center, Hampton, Va.
(Phone: 804/864-6124)

RELEASE: 94-39

NASA ACQUIRES BOEING 757 FOR AERONAUTICAL FLIGHT RESEARCH

NASA is scheduled to take delivery on March 24 of a Boeing 757-200 aircraft that will serve as a "flying laboratory" for aeronautical research. The aircraft will be modified extensively for a broad range of flight research programs to benefit the U.S. aviation industry and commercial airline customers.

The aircraft will be used to conduct research to increase aircraft safety, operating efficiency and compatibility with future air traffic control systems. It will serve as a vital research tool in support of the agency's Advanced Subsonic Transport and High-Speed Research programs.

The 757 will continue the work begun by the NASA 737-100 in state-of-the-art technologies such as electronic cockpit displays, flight management systems and flight safety devices such as airborne windshear detection sensors. Current and projected research needs greatly exceed the capabilities of the 737.

The NASA 757 was located after an extensive survey of the jet airliner market. It was used by Boeing for Federal Aviation Administration certification of the 757 class of jet airliners. The second generation, digitally-equipped transport designated N501EA, will be obtained from the Eastern Airline bankruptcy estate.

NASA is acquiring the aircraft for \$24 million, to be paid over 2 fiscal years. The 757 will be maintained and flown by NASA's Langley Research Center, Hampton, Va.

- end -

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For Release

March 14, 1994

Linda S. Ellis
Lewis Research Center, Cleveland
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RELEASE: 94-41

HIGH-SPEED ENGINE CYCLES TAPPED FOR FURTHER RESEARCH

A NASA-industry team has chosen two engine cycle concepts on which to focus the next 3 years of propulsion research for a next-generation supersonic airliner.

The "mixed flow turbofan" and "FLADE" (fan-on-blade) concepts were selected from six candidate engine cycles being considered in NASA's High-Speed Research Program, which is developing technology to make a future U.S. supersonic airliner environmentally compatible and economically practical.

"Both concepts promise to meet the economic and environmental goals for a new supersonic airliner," said NASA program Director Louis J. Williams. "Concentrating our propulsion research on these designs brings us one step closer to making this type of airplane a reality."

NASA and industry selected the mixed flow turbofan and FLADE concepts because studies showed they were the best candidates in terms of direct operating costs to the airlines, noise reduction, adverse atmospheric effects and technological risk. Both concepts should reduce engine takeoff noise while maintaining good performance at supersonic speeds.

These engine cycles cut jet noise by mixing low-energy air with engine high-energy exhaust flows during takeoff. The mixed flow turbofan has a secondary, slower-moving airstream that bypasses most of the engine's turbomachinery but rejoins the airflow before reaching the engine exhaust nozzle. The FLADE is a modified turbofan engine that introduces an additional airstream up front in the engine fan.

-more-

-2-

NASA and industry will study these two concepts for the next 2 years before choosing one of them on which to focus technology development in the remaining years of the High-Speed Research Program. After that choice is made, large scale tests of the critical propulsion components -- inlet, fan, combustion chamber and nozzle -- would be done between 1998 and 2001, giving industry the data it needs for an informed decision to build a new supersonic airliner.

-end-

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For Release

March 14, 1994

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Goddard Space Flight Center, Greenbelt, Md.
(Phone: 301/286-5565)

RELEASE: 94-42

NASA OPENS GROUND STATION FOR COMPTON GAMMA-RAY OBSERVATORY

NASA has opened a new, remote ground station in Tidbinbilla, Australia, called the GRO Remote Terminal System, to receive scientific data from the Compton Gamma-Ray Observatory (GRO) via a Tracking and Data Relay Satellite (TDRS) that was moved into position over the Indian Ocean.

The decision to build the ground station and devote a TDRS to the Compton GRO came after the observatory's tape recorders failed, restricting transmission of scientific data to real time only. Since Compton was compatible with TDRS, this ground station option was feasible. An on-orbit repair of Compton GRO was an alternative, but would have been much more costly.

"While the new ground station is devoted to Compton at this time, it has the potential for use by other Earth-orbital spacecraft. The TDRS system was designed to operate with all the TDRS spacecraft in view of a single ground station. As a result, coverage could not be provided in a small region on Earth -- the so-called Zone of Exclusion over the Indian Ocean.

"With activation of this ground facility, the TDRS system can, for the first time, provide global coverage," said Charles Force, Associate Administrator, Office of Space Communications, NASA Headquarters, Washington, D.C.

Work on the station was completed in a relatively short time and within its \$12 million budget. Work began in September 1992 to implement a remotely controlled terminal at an existing NASA site and was a cooperative effort between the Australian Space Office and NASA

- more -

"We're very pleased that this project came in on budget and on time and that we are able to collect additional significant data from Compton in a cost-effective manner," said Frank Stocklin, Head, Radio and Frequency Interface and Mission Analysis Section, Goddard Space Flight Center (GSFC), Greenbelt, Md.

With GRO tape recorders not working, the observatory had been able to relay only slightly more than half of the science data it collected, because it could not point at a TDRS at all times. While coverage had been about 65 percent of each orbit, scientists could not collect that percentage of data because Compton's instruments had to be turned off during the part of the orbit when the spacecraft passed through the background radiation caused by the South Atlantic Anomaly.

"That had represented a significant obstacle to the scientific teams, even though we have been able to collect more science than expected," said Goddard's Dr. Neil Gehrels, Compton Project Scientist. "Now with the ground station and the TDRS, we're back where we want to be."

With a TDRS devoted to Compton, scientists will be able to collect about 30 percent more science. In addition, engineers will be able to keep better tabs on the health of the \$500-million observatory, launched from the Space Shuttle Atlantis (STS-37) on April 5, 1991.

"It's difficult to place a dollar value on the additional science data obtained in this effort," Stocklin said, "but the restoration of data recovery capability is similar to that done for the Hubble Space Telescope and marks the second successful recovery of a major NASA observatory."

TDRSs receive data from Earth-orbiting satellites and re-transmits the data to a ground terminal in White Sands, N.M. Data from the Compton will be relayed from TDRS-1 to Tidbinbilla to an Intelsat satellite to a West Coast location and then routed to White Sands. Data then will be distributed to scientists around the world. Control of TDRS-1 and this highly automated ground terminal remains at White Sands, N.M., marking the first time NASA is controlling an out-of-view TDRS from that location.

Launched in 1983, TDRS-1 was the first satellite in the TDRS system and was operating beyond the end of its design life of 8 years when it was moved over the Indian Ocean. TDRS-1 had been located at 171 degrees west longitude over the Pacific. It is now at 85 degrees east longitude, in view of the Tidbinbilla ground station.

"In its current use, TDRS-1's useful life may be extended to the end of the decade and perhaps beyond," Stocklin said.

Dwayne C. Brown
Headquarters, Washington, D.C.
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For Release

March 14, 1994

RELEASE: 94-43

NASA INITIATING INDUSTRY TESTING PROGRAM VIA SATELLITE NETWORK

NASA's Office of Space Communications, Headquarters, Washington, D.C., is initiating an opportunity for private industry to conduct experiments and demonstrations of future telecommunications technologies via the Tracking and Data Relay Satellite System (TDRSS).

Called the Mobile Satcom TDRSS (MOST) Experiment Program, it will enhance U.S. competitiveness in the rapidly expanding global satellite telecommunications arena.

"In accord with NASA's statutory responsibilities, this program will contribute significantly to U.S. knowledge in emerging satellite technologies and communications concepts. This use of TDRSS is made possible by the versatile and unique capabilities of our Tracking and Data Relay Satellite System," said Charles Force, Associate Administrator for Space Communications, Washington, D.C.

The MOST program will help to increase efficiency and lower costs in the deployment of future low-Earth orbiting satellites, applications of rural and remote business communications, ground transportation tracking and messaging, commercial air carrier fleet management including messaging for location, inflight mechanical failures, weather conditions and enroute delays, and communications that include cellular telephone service, facsimile and personal paging services.

"These technologies, once tested and eventually developed, will allow industry to develop new telecommunications users and enhance the 'information superhighway' of our future. We anticipate experiments will begin sometime this fall," said Arthur Jackson, MOST Project Manager, Goddard Space Flight Center (GSFC), Greenbelt, Md.

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"Use of the TDRSS space and ground segments will be made available free of charge to interested parties. It will be offered to U.S. entities for experiments and demonstrations only. Experimenters cannot use the system for routine business operations. The commercial applications these experiments enable, must be implemented in nearby non-government frequency bands. In addition, experimenters will be responsible for providing all equipment and personnel required to perform the experiments," said Katherine Chambers, Aerospace Telecommunications Engineer, Space Network Division, NASA Headquarters, Washington, D.C.

Interested parties will be requested to provide a proposal detailing user requirements, extent of experimentation and time required for scheduling and development of equipment and other resources required for experiments or demonstrations. An agreement will be arranged so as not to interfere with TDRSS's primary mission operations activities.

U.S. corporations interested in participating in the program may contact Katherine Chambers at NASA Headquarters, Washington, D.C., 202/358-4830. A workshop will be held in April 14-15, to provide detailed information. Universities and government agencies are welcome.

TDRSS is a space-based network that provides communications, tracking, telemetry, data acquisition and command services essential to Shuttle and low-Earth orbital spacecraft missions. All Space Shuttle missions and nearly all NASA spacecraft in Earth orbit require the TDRSS's capabilities for mission success.

The TDRSS consists of two major elements -- A constellation of geosynchronous satellites and a ground terminal located at White Sands, N.M. NASA's GSFC manages the daily operation of the system. The Office of Space Communications, Washington, D.C., has overall management responsibility.

-end-

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For Release

March 15, 1994

RELEASE: 94-44

SPACE SHUTTLE MODIFICATION WORK TO CONTINUE AT PALMDALE

NASA Space Shuttle Director Tom Utsman today announced that the agency's intent is to accomplish all major modification work on the Space Shuttle fleet at Rockwell International's facility in Palmdale, Calif.

In arriving at this decision, Utsman cited several factors including the expanding requirements associated with the Russian cooperative effort, the ability to support future operations of the international Space Station and the desire to continue to prelaunch process the Shuttle orbiters for flight at the Kennedy Space Center (KSC), Fla., in the most efficient manner possible.

"After evaluating the location for performing major modifications to the Space Shuttle orbiters, I believe the best policy is to continue to perform these modifications at the Palmdale facilities. This will allow the KSC team to concentrate all its efforts on the safe and efficient Shuttle vehicle prelaunch processing," said Utsman.

"This decision will allow the Shuttle orbiter major modification effort to be performed by approximately 300 workers located at Palmdale while the 7,000 KSC member team can concentrate their efforts on safe and efficient vehicle processing," Utsman said.

Space Shuttle Atlantis, undergoing major modification work at Palmdale to allow it to dock with the Mir Space Station, is scheduled to return to KSC in June in preparation for the STS-66 mission this fall. Following that mission, Atlantis will fly the first docking mission with Mir on Shuttle Mission STS-71, scheduled for launch in June 1995.

Future major modification work scheduled at Palmdale will include preparing a second orbiter -- Discovery -- to have the ability to dock with the Mir Space Station so that it can help support the first phase of the new Russian cooperative effort.

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Phase One consists of up to 10 Space Shuttle-Mir missions including rendezvous, docking and crew transfers between 1995 and 1997. The Space Shuttles will assist with crew exchange, resupply and payload activities for Mir.

Discovery also is scheduled to have installed the initial work associated with the Multifunctional Electronic Display System (MEDS), a 5th cryogenic tank set, the same Mir modifications done to Atlantis so that Discovery can support Phase One cooperative efforts and have the removal of the internal airlock and installation of a new external airlock to support the future international Space Station.

The decision to continue major modification work at Palmdale and make a second orbiter capable of Mir docking will have a slight impact on the near-term Shuttle manifest.

Space Shuttle Columbia, currently in orbit on the STS-62 mission and next in line for major modification work, will be sent to Palmdale following its next mission, the STS-65 mission. The STS-67/ASTRO-2 mission, originally scheduled for Columbia in December 1994, will be flown aboard Endeavour in early January 1995.

Columbia is expected to arrive at Palmdale in September 1994 with work projected to last 7 to 8 months. Among the improvements scheduled for Columbia is the initial work associated with the MEDS system.

Discovery will be sent to Palmdale following the STS-70 mission. It is expected to arrive at Palmdale in September 1995 where it will remain for 7 to 8 months. Following modification, it will fly a docking mission with Mir on Shuttle Mission STS-79 in June 1996.

To obtain the maximum efficiency while the modification work is underway, normal inspections and evaluations associated with the Orbiter Modification Down Period (OMDP) also will be performed at Palmdale. Each orbiter is required to go through an OMDP about every 3 years so that technicians can make structural evaluations on the various Shuttle systems.

NASA News

National Aeronautics and
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For Release
March 17, 1994

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RELEASE: 94-45

SPACE STATION PROGRAM MARKS MAJOR MILESTONE

The International Space Station Program will cross a major milestone next week when program managers from NASA, the international partners and the contractor community meet to review and evaluate the design status of the orbiting laboratory.

At the System Design Review (SDR), set for March 23 and 24 at the Johnson Space Center (JSC), Houston, program managers will validate overall technical requirements for the space station and take a preliminary look at how the requirements will be accomplished.

"This is where we move from concepts to hardware implementation," said Randy Brinkley, Space Station Program Manager. "This is by far the most important technical milestone in the program since last year's redesign of the station. The SDR will lock in the key technical elements of the system as well as the schedule and cost."

The SDR will include managers from NASA; the Canadian Space Agency; the European Space Agency (ESA); the Italian Space Agency (Agenzia Spaziale Italiana); the Japanese Space Agency (NASDA); the Russian Space Agency; the prime contractor Boeing; and Tier I subcontractors Rocketdyne and McDonnell Douglas.

The SDR will establish the technical baseline of the entire program and is an extension of the SDR process conducted in December. The SDR documentation has been reviewed concurrently by program analysis and integration teams and integrated product teams. NASA, the international partners, Boeing and the Tier I subcontractors all have participants on the teams developing the SDR documents.

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The 2-day meeting is intended to be an executive summary and overview of the SDR process results. Participants will review the operation and utilization concept, the baseline assembly sequence and assembly operations. For the international space station, this includes the specifications for the U.S. on-orbit components, U.S. ground components, ESA's Columbus Laboratory Module and the Japanese Experiment Module.

Participants also will look at the basic design of the station's core systems including electrical power; thermal control; life support; guidance, navigation and control; propulsion; command and data handling; communications and tracking; and extravehicular activities. Risk and affordability also will be assessed. The analysis at SDR will demonstrate the feasibility of the requirements and establish the physical and functional interfaces between system elements including software and hardware.

The overall objective of the meeting is to reach a consensus among program managers on the technical validity, design and completeness for the space station system specifications; the operations concept; requirements for interfaces with the Space Shuttle and Russian launch vehicles; and to refine cost and program schedules. This is an important checkpoint for the program, Brinkley said. "This review gives us an opportunity to assess the developing design to ensure that it meets program objectives and requirements."

Over the next year, the space station team will refine the design to more detailed levels and finalize it at the Critical Design Review currently scheduled for April 1995.

"Since last year's redesign of the space station, NASA has made significant progress with the international partners and contractor team to provide -- on schedule and within budget -- a world-class, space-based research facility," Brinkley said.

"By using about 75 percent of the hardware planned for Space Station Freedom, NASA has been able to maintain its investment to date while redesigning the system to be less expensive and more capable," he said. "The international community of researchers, scientists and industry that comprises the International Space Station users will have access to an unprecedented amount of power, volume and crew time to conduct investigations in the microgravity environment of space," Brinkley concluded.

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NOTE TO EDITORS: Managers from NASA, the international partners and Boeing will meet with the press at JSC to discuss the review on March 24 at 4 p.m. EST. The press conference will be carried on NASA Select TV.

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NASA Select Television is carried on Spacenet 2, transponder 5, located at 69 degrees West longitude, frequency 3880.0 MHz, audio 6.8 MHz. Video of the SDR in progress and animation of the current design will be broadcast on NASA Select immediately following the press conference.

Photographs of the three phases of the International Space Station Program are available from JSC's Still Photo Library by calling 713/483-4231. Animation of the station configuration also will be available March 23 from the Film and Video Distribution Library at 713/486-9606.

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For Release

March 17, 1994

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RELEASE: 94-46

NASA HOSTS NATIONAL AEROSPACE EDUCATION CONFERENCE

The National Aeronautics and Space Administration will host, in cooperation with the Civil Air Patrol and the Federal Aviation Administration, the nation's premier conference for educators in the fields of aviation and space on April 6-9 in Norfolk, Va.

More than 1,000 educators and leaders in the aerospace industry are expected to attend the 27th annual National Congress on Aviation and Space Education (NCASE). This year's theme is "Aviation and Space Education: America's Leading Edge."

The conference is designed to capture the interest of young people in the wonders of aviation, science, mathematics and advanced technology, while individual sessions are developed to challenge, guide and stimulate the abilities of the educators and their students.

NCASE provides attenders with an opportunity to hear experts from the aerospace industry and the U.S. government and to meet with their peers and share what they are doing in their classrooms. Sessions are geared to cover all grade levels from kindergarten through university.

Paul Holloway, Director of NASA's Langley Research Center, Hampton, Va., will open the conference proceedings on April 7. Featured NASA speakers will include Capt. Robert L. "Hoot" Gibson, astronaut; Dr. Wesley L. Harris, Associate Administrator for Aeronautics; and Frederick D. Gregory, Associate Administrator For Safety And Mission Assurance.

- more -

Other speakers from government and industry include USAF Brig. General Marcelite J. Harris; James W. Kohlmoos, U.S. Department of Education; USAF Lt. General Jay W. Kelly; Scott Siansburg, mathematician; Dr. Guion S. Bluford, a former NASA astronaut and currently Vice President and General Manager of Engineering Services Division at Nyma, Inc; Dr. William C. Boshier, Jr., Superintendent for the Virginia Department of Public Instruction; Ed Fitzsimmons, Office of Science and Technology Policy at The White House; and William M. Bower, USAF (Ret.)

The conference will be held at the Norfolk Waterside Convention Center, 215 E. Main St., Norfolk, Va. For more information or to register for the conference, call 1-800/789-7887.

NASA News

National Aeronautics and
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Washington, D.C. 20546
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For Release

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March 17, 1994

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RELEASE: 94-47

PAYLOAD COMMANDER, MISSION SPECIALIST NAMED TO STS-73

Dr. Kathryn C. Thornton, Ph.D., has been named Payload Commander of the second United States Microgravity Laboratory mission (USML-2) scheduled for launch in the fall of 1995 aboard Space Shuttle Columbia. Also chosen as a mission specialist was Dr. Catherine G. "Cady" Coleman, Ph.D. (Captain, USAF).

STS-73, presently scheduled to last 16 days, will become the longest mission in Space Shuttle program history and is designed to continue laying the foundation for microgravity research conducted over extended durations in space.

USML-2 follows the first microgravity laboratory mission, STS-50, flown in June and July 1992. The mission will continue the series of Shuttle flights dedicated to studying microgravity materials processing technology through research sponsored by government, industry and academia. The mission will focus on materials science, biotechnology, combustion science, the physics of fluids and many other scientific experiments to be housed in the pressurized Spacelab module.

For Thornton, STS-73 will be her fourth Shuttle flight. She first flew aboard Discovery on a Department of Defense mission (STS-33) in November 1989. Her second flight was in May 1992 on the maiden voyage of Endeavour (STS-49) to rescue and repair the Intelsat spacecraft and to examine assembly techniques for large space structures such as the international space station. On that flight, Thornton evaluated assembly techniques during 1 of 4 spacewalks.

Thornton's most recent flight in December 1993 was aboard Endeavour as a member of the crew sent to carry out the first servicing of the Hubble Space Telescope (STS-61). On that flight, she was 1 of 4 astronauts that conducted a record 5 spacewalks.

- more -

Coleman will be making her first flight on the Space Shuttle. She was selected to be an astronaut in 1992. Coleman graduated from W. T. Woodson High School in Fairfax, Va., in 1978. She earned a bachelor of science degree in chemistry from the Massachusetts Institute of Technology in 1983 and a doctorate in polymer science and engineering from the University of Massachusetts in 1991.

Since completion of astronaut training, Coleman has supported the Astronaut Office Mission Support Branch, assisting with flight software verification in the Shuttle Avionics Integration Laboratory.

NASA News

National Aeronautics and
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For Release
March 18, 1994

N94-21: NOTE TO EDITORS

PRESS KIT DISTRIBUTION CHANGES IMPLEMENTED

Beginning with the STS-59 mission, Space Shuttle press kits and all other major NASA project press kits, distributed by mail from NASA Headquarters, will be limited to domestic media representatives. This change in distribution policy is necessitated by severe NASA Headquarters funding reductions.

As in the past, all press kits will be available from the NASA field center newsrooms. Also, the kit's text will continue to be available electronically through CompuServe and in the next few months, will be stored on the Internet.

It is anticipated that by mid-summer NASA Headquarters news material (press releases, notes to editors, status reports, etc.) will no longer be mailed. However, all material will be available by facsimile, a new service called Fax-on-Demand, CompuServe and Internet. Notification will be made as these services are activated.

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Debra J. Rahn
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For Release

March 18, 1994

EDITORS NOTE: N94-23

RUSSIA INTEGRATION INTO SPACE STATION PARTNERSHIP DISCUSSED

The United States, Canada, Japan and the European Partner met in Paris, France, today, with government officials of the Russian Federation for the first time to discuss steps to implement the decision to bring Russia into the Space Station partnership. The joint statement, summarizing the results of the meeting, is being issued today by all the participants.

JOINT STATEMENT ON NEGOTIATIONS RELATED TO THE INTEGRATION OF RUSSIA INTO THE SPACE STATION PARTNERSHIP

Representatives of the governments of the United States, Canada, Japan, and the European Partner met for the first time with representatives of the government of the Russian Federation to discuss steps to implement the decision to bring Russia into the partnership. They stressed their interest in Russia joining the international Space Station program as a full partner as soon as possible. Russian involvement in the international Space Station will help realize the benefits of global partnership and further develop the shared objective of building broad cooperative relationships.

The Russian delegation informed the participants of the key parameters of Russia's planned contribution to the partnership, which will result in a Space Station with enhanced capabilities. The representatives considered the approach to changes to the legal framework of the 1988 agreements on Space Station cooperation that will be needed to include Russia as a Partner, as well as to complete any other necessary adjustments. They also discussed the modalities for negotiating those changes, including a schedule that would allow for early completion of negotiations. The first meeting of the negotiating delegations is planned for April 1994.

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The intergovernmental meeting today follows the decision of the Partners in Paris on October 16, 1993, to explore collectively possible Russian partnership, and the Russian acceptance of the formal invitation extended by the partnership as a result of its December 6, 1993, meeting in Washington. The meeting also follows the November 7, 1993, informal meeting in Montreal of Heads of the United States National Aeronautics and Space Administration, the Canadian Space Agency, the National Space Development Agency of Japan, the European Space Agency and the Russian Space Agency covering preliminary technical aspects of Russia's intended participation.

- end -

For Release

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Headquarters, Washington, D.C.
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March 21, 1994

RELEASE: 94-48

WINSTON-SALEM UNIVERSITY TO PARTICIPATE IN JOINT NASA VENTURE

NASA announced today that two Winston-Salem State University faculty members have been selected to participate in the NASA/University Joint Venture Program (JOVE). The program provides opportunities for faculty members and students to become involved in space science research and makes available new linkages between NASA and a broader segment of American institutions of higher education.

"NASA is committed to investing in the scientific and economic future of this country," said NASA Administrator Daniel S. Goldin. "Programs such as JOVE are an important part of that investment."

JOVE is a NASA-sponsored research program designed to build greater research capabilities at American colleges and universities which have had little or no involvement with the U.S. space program. To qualify for the program, an institution must have received less than \$100,000 in research funding from NASA. Two other North Carolina institutions, Fayetteville State University and Guilford College, also participate in the JOVE program.

"The world is changing, giving us new scientific and technological challenges every day," said Goldin. "To confront these challenges, we need the new ideas, new methods and new information we will get from schools such as Winston-Salem State."

NASA will invest \$138,000 over three years to support Winston-Salem State's participation in the program. As part of the program, two members of the university faculty will travel to NASA field centers for 10 weeks this summer to begin a program of "mentoring" by agency scientists.

Dr. Fenglien Frank Lee, a faculty member of the Computer Science department, will collaborate with Dr. John Hogge of NASA's Science department. They will focus on ways to use information systems to stimulate minority students to pursue studies in science and engineering.

-more-

Dr. Elva Jones, Chairperson of the Computer Science Department at Winston-Salem, will collaborate with Valerie Thomas, Assistant Chief of the Space Science Data Operations, at NASA's Goddard Space Flight Center. They will focus on ways to use information systems to stimulate minority students to pursue studies in science and engineering.

Electronic network links between Winston Salem State and NASA will be established and when the professors return to school in the fall, they will use their work at Langley and Goddard to develop additional science curricula and joint research.

The JOVE program was initiated in 1989 out of the belief that the large amounts of data produced by the space missions of the 1990's would provide significant opportunities for greater understanding of physical, biological and chemical processes. The program was begun to extend this data and NASA's resources to a larger segment of the educational community and make a greater share of the country's academic research capability available to the agency as it attempted to use the data.

"We have great hopes that partnerships like the JOVE program will lead to the kind of innovation and creativity we depend on at NASA," said Goldin. "I am very pleased that we will be working with Winston-Salem State University."

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For Release

Sarah Keegan
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March 22, 1994

Franklin O'Donnell
Jet Propulsion Laboratory, Pasadena, Calif.
(Phone: 818/354-5011)

EDITORS NOTE: N94-25

ASTEROID MOON PHOTO TO BE RELEASED AT PRESS CONFERENCE

The first ever photograph of a moon of an asteroid, taken by NASA's Galileo spacecraft, will be released at a press conference Wednesday, March 23.

The press conference, beginning at 1 p.m. EST, will originate from NASA's Jet Propulsion Laboratory, Pasadena, Calif., and will be carried live on NASA Select television with two-way question and answer capability.

Discussing the major discovery will be William O'Neil, Galileo project manager; Dr. Torrence Johnson, Galileo project scientist; Dr. Michael Belton, team leader for Galileo's imaging system; Dr. Robert Carlson, principal investigator for Galileo's near-infrared mapping spectrometer; and Dr. Clark Chapman, a member of the Galileo imaging team.

Galileo took pictures of and collected other data on the small moon of the asteroid Ida during its flyby last Aug. 28. The images were not received on Earth until recently because the spacecraft is transmitting over its low-gain antenna at a very slow rate.

NASA Select is available on Spacenet 2, transponder 5, channel 9, 69 degrees West, transponder frequency is 3880 MHz, audio subcarrier is 6.8 MHz, polarization is horizontal.

-end-

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For Release

March 22, 1994

Diane Farrar
Ames Research Center, Mountain View, Calif.
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RELEASE: 94-49

NASA DEVELOPS PLAN TO SEARCH FOR MARTIAN FOSSILS

A scientist at NASA Ames Research Center, Mountain View, Calif., has developed a strategy to search for microfossils on the planet Mars. His criteria are helping to guide site selections related to the search for evidence of past life on Mars during upcoming Mars missions planned for later this decade.

"Our focus in the search for life (exobiology) on Mars has shifted to the search for ancient life because of the formidable conditions on the martian surface," said Dr. Jack Farmer. Farmer is a paleontologist and geologist at Ames.

Exobiology is the study of the origin, evolution and distribution of life in the universe. Farmer calls his newly invented discipline expaleontology.

Farmer, with colleagues at Arizona State University, has catalogued and prioritized the sites on the martian planet most likely to conceal well-preserved microbial fossils. He bases his strategy on the principles of Precambrian paleontology, the study of the Earth's earliest fossil record.

The Precambrian era includes more than 90 percent of Earth's history. Beginning before the time of the oldest Earth rocks dated 3.9 billion years ago, it continues to the explosion of complex multicellular life of about 540 million years ago.

Many scientists think that ancient Mars was a much warmer, more volcanically active planet with a dense atmosphere and abundant water.

The largest volcano in the solar system is on Mars. Olympus Mons, probably now dormant, is three times the height of Mt. Everest. River channels and lake basins carved into Mars' now-dusty terrain show vast amounts of water were once present on the planet's surface.

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The channels and lake basins are concentrated in the oldest, most heavily cratered terrains of Mars. These areas are believed to be the same age as the earliest microbial fossils on Earth -- about 3.5 billion years old, Farmer said.

Since microbial communities developed on Earth in less than a billion years, it is plausible that organisms also developed on an early warm and wet Mars, he said.

If life developed on Mars, it is likely to have left a fossil record. According to Farmer, the best locations to hunt for martian fossils are where nutrient-rich water once bubbled to the surface as hot springs.

Farmer, with Drs. David Des Marais of Ames and Malcolm Walter from Australia, has studied hot spring deposits in Yellowstone National Park to learn how to recognize them on Mars.

"Where organisms coexisted with early mineralization, we have the potential for preserving soft-bodied microbes, sometimes for billions of years," he said.

"The hot water bubbling off carbon dioxide gases creates alkaline conditions. This encourages minerals like silica and carbonate to separate out. The precipitating minerals encase and bury organisms and even entire microbial mats," he said.

Silicous thermal springs are the best places to look because silica is relatively stable and has a long residence time in Earth's crust, Farmer said. Carbonates are more soluble than silica, he said, but can still preserve soft-bodied microorganisms for billions of years.

Microbes also coexist with precipitating minerals in evaporating lakes like Mono Lake in California, another site being studied by Farmer.

Spring deposits on lake bottoms often form at lower temperatures that do not deteriorate the organic material as much as a high temperature spring. Microbes trapped in these deposits can be preserved for hundreds of millions of years, he said.

Lakes can also evaporate, leaving salt that entraps the cell walls and extracellular material of microbes. However, salt tends to dissolve easily. If a surface water cycle is active, its crustal residence time is short, Farmer said.

Farmer presented his research at the Geological Society Meeting of America in San Bernardino, Calif. Farmer and his colleagues recently compiled a catalog that includes Mars exobiology sites. NASA will publish the catalog later this year.

NASA News

National Aeronautics and
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Washington, D.C. 20546
AC 202 358-1600



For Release

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March 23, 1994

Franklin O'Donnell
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RELEASE: 94-50

GALILEO DISCOVERS MOON OF ASTEROID

The first-ever photograph of a moon of an asteroid, sent to Earth by NASA's Galileo spacecraft, was released by the space agency today.

The photo of Asteroid 243 Ida and its newly discovered natural satellite was taken by Galileo as the spacecraft flew past Ida last Aug. 28. It was not transmitted to Earth until recently because the spacecraft is sending back data at a very slow rate.

According to team scientists at NASA's Jet Propulsion Laboratory (JPL), Pasadena, Calif., the image together with data from Galileo's near-infrared mapping spectrometer are the first conclusive evidence that natural satellites of asteroids exist.

The discovery gives scientists an intriguing new clue in deciphering the origins and evolution of these ancient rocky bodies, most of which orbit the sun in the main asteroid belt between Mars and Jupiter.

Even so, many pieces of information on the newly found moon -- where it came from, how it came to be orbiting Ida and the details of that orbit -- are still unclear.

"It previously was thought that natural satellites of asteroids could form, but they probably weren't common," said Dr. Torrence Johnson, Galileo Project Scientist. "Having found one fairly quickly, we can say that they're probably more common than previously thought."

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From the photo and spectrometer data, team scientists estimate that the natural satellite is about 1 mile (1.5 kilometer) across in this view and appears to be at a distance of about 60 miles (100 kilometers), plus or minus 30 miles (50 kilometers), from Ida's center. The position will be more accurately determined as new data are analyzed. Ida itself is about 35 by 15 by 13 miles (56 by 24 by 21 kilometers) in size.

As yet they do not know the parameters of the object's orbit -- critical information that can reveal Ida's mass. Combining these measurements of Ida's size and volume can tell scientists the asteroid's density, offering more clues as to what it is made of.

The data from Galileo's near-infrared mapping spectrometer -- which scans space objects at a variety of wavelengths to reveal their chemical compositions -- suggest that Ida's moon is made more or less from the same kind of material as Ida. Ida is an S-type asteroid, composed mostly of silicate rocks.

Scientists are certain, in any event, that the moon's surface is not composed mostly of carbonaceous material, as are the many asteroids that are termed C-type asteroids.

Further information on the object's composition will become available as color pictures and more detailed data from the spectrometer are transmitted to Earth over the next few months.

Galileo scientists believe the moon may have been created at the same time as Ida -- when an older, larger asteroid was shattered by a collision with another asteroid, giving birth to dozens of smaller asteroids.

Ida is a member of the Koronis family of asteroids, which scientists believe was created when a larger body perhaps 120 to 180 miles (200 to 300 kilometers) in diameter was smashed relatively recently -- at least considerably after the solar system formed some 4.5 billion years ago. (The family was named for Koronis, one of the asteroids that belongs to it.)

Alternatively, it is possible that Ida was hit by a smaller object even more recently, leaving a crater on the asteroid and throwing off the material that became the small moon.

"Ida's age is baffling, because the craters visible on its surface suggest that it is old, but being a part of the Koronis family suggests it is younger," said Johnson.

"In any event, we don't believe that Ida and its moon could go back to the formation of the solar system," he added. "It's generally thought that a small object like that moon could not survive this long; sooner or later it would itself be broken up in a high-speed collision with an even smaller asteroid."

Galileo scientists also believe it is virtually impossible that the moon is a "captured object," something created completely separate from Ida that happened to wander near the asteroid and be caught by its gravitational field. According to the laws of celestial mechanics, such an event would deflect the smaller object, but would not capture it into an orbit unless a third force of some kind slowed it down.

"Once we have determined the object's orbit, we can estimate timescales and make better guesses as to where it came from," said Johnson.

Launched in October 1989, Galileo made its closest approach to Ida at a distance of 1,500 miles (2,400 kilometers) last August while flying through the asteroid belt en route to its final destination -- the giant planet Jupiter, where it will go into orbit in Dec. 1995.

Because Galileo is transmitting data back to Earth through its low-gain radio antenna, it must transmit at slow rates. One picture of Ida -- a mosaic of five separate frames -- was received shortly after the flyby, but later pictures had to wait because telecommunications conditions became unfavorable as Galileo's distance from Earth increased. In the meantime data were stored on Galileo's onboard tape recorder awaiting playback this spring.

Scientists say that the newly found moon was outside the boundaries of the picture of Ida released last September.

Ground controllers instructed Galileo to send back more portions of photos and other data beginning in February as the spacecraft's distance from Earth decreased and radio communications with the spacecraft improved.

In preparation for complete playback, they commanded the spacecraft to transmit strips of each image -- called "jail bars" by the project's engineers and scientists -- so that they could locate Ida accurately within images stored on Galileo's recorder. Later, portions of an image containing Ida could be selected for playback in entirety.

On Feb. 17 -- a day after the first of these "jail bars" was sent back from Galileo -- evidence of the natural satellite was noticed in one set of image strips by Ann Harch, a Galileo imaging team associate at JPL. It took several days to verify that what appeared to be a moon was not actually an artificial effect of some kind.

On Feb. 23, scientists examining similar preliminary data from a chemical map obtained by the near-infrared mapping spectrometer discovered an unusual object in their data. By Feb. 28, scientists from both the camera and spectrometer teams concluded that they had a confirmation.

Amateur astronomers for many years have observed the light of stars blinking off and on as objects such as asteroids pass in front of them in events called stellar occultations. Some have reported "blinkouts" that suggest that some asteroids have moons, but such reports have never been confirmed by definite second sightings. Galileo's discovery is thus the first unambiguous evidence of an asteroid moon.

Other images that may show the asteroid moon are still stored on Galileo's tape recorder and will be played back later this spring. Among them is an image that is expected to be at least three times sharper than the first image received.

The newly found moon has been provisionally designated "1993 (243) 1" -- meaning that it is the first natural satellite discovered in 1993 at Ida, which was the 243rd asteroid discovered over the past 2 centuries. The moon will be formally named later by the International Astronomical Union.

JPL manages the Galileo Project for NASA's Office of Space Science.

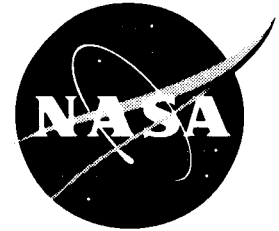
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NOTE TO EDITORS: Black and white images are available to media from NASA's Broadcast and Imaging Branch, 202/358-1900. Photo numbers are: 94-H-140 and 94-H-141.

NASA News

National Aeronautics and
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Washington, D.C. 20546
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For Release

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March 23, 1994

RELEASE: 94-51

NASA AND BRAZIL SIGN SOUNDING ROCKET CAMPAIGN AGREEMENT

NASA and the Commission for Space Activities of the Federative Republic of Brazil (COBAE) have signed a memorandum of understanding to conduct a sounding rocket campaign in Brazil from July through October 1994. The agreement was signed by Daniel S. Goldin, NASA Administrator, and by Admiral Arnaldo Leite Pereira, President of COBAE.

The sounding rocket campaign will investigate the electrodynamics and irregularities in the ionosphere and mesosphere along the Earth's magnetic equator and will study their relationship with the neutral atmosphere and winds. The sounding rocket experiments primarily will measure electric fields, currents, densities, neutral winds and ionospheric instabilities.

The campaign involves the launch of 33 NASA rockets. Over 50 U.S. and Brazilian scientists will participate, supported by teams of approximately 300 engineers, technicians and support staff.

The launches will take place at the new Brazilian Launch Range, known as the Centro de Lancamentos de Alcantara (CLA) in the northeastern state of Maranhao. This launch range is within 1 degree of the Earth's magnetic equator. COBAE will provide launch support services to NASA.

The sounding rocket experiments require simultaneous measurements taken by ground-based scientific instruments, including backscatter radars, magnetometers and ionosondes.

NASA plans to fly a Brazilian science experiment as part of one of the payloads. The Brazilian scientific participation is coordinated by the Instituto Nacional de Pesquisas Espaciais (INPE). Both sides will share the data from the rocket-borne and ground-based instruments.

The project has been named the Guara Campaign after a beautiful species of bird native to the equatorial region of Brazil.

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National Aeronautics and
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For Release
March 24, 1994

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NOTE TO EDITORS: N94-26

NASA SETS APRIL 7 FOR STS-59 LAUNCH

NASA managers today set April 7, 1994 as the official launch date for Shuttle Mission STS-59. Space Shuttle Endeavour with a six-person crew will conduct the first flight of the Space Radar Laboratory payload which will provide scientists around the world with a unique vantage point for studying how the Earth's global environment is changing.

The launch on April 7 from the Kennedy Space Center (KSC), Fla., is currently planned for 8:07 a.m. EDT at the start of a 2 1/2 hour available window. The launch team is protecting an option in the countdown timeline which would allow Endeavour to launch one hour sooner at 7:07 a.m. EDT. By building flexibility into the launch time, NASA managers can evaluate predicted climatological and atmospheric conditions for the KSC area during the final part of the countdown and then select the optimum time for launch. A specific launch time will be decided no later than 24 hours before launch.

The planned STS-59 mission duration is 9 days, 5 hours, 7 min. A launch on April 7 at 8:07 a.m. EDT would produce a landing at 1:14 p.m. EDT on April 16 at KSC.

Leading the STS-59 crew will be Mission Commander Sidney M. Gutierrez who will be making his second flight. Pilot for the mission is Kevin P. Chilton who is making his second flight. The four mission specialists aboard Endeavour are Linda M. Godwin, the STS-59 Payload Commander who will be making her second flight, Jerome Apt who will be making his third flight, Michael R. "Rich" Clifford who will be making his second flight and Thomas D. Jones who will be making his first flight.

- end -

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For Release
March 24, 1994

EDITORS NOTE: N94-27

GOLDIN'S RESPONSE TO THE CBO REPORT

NASA will not back away from the Administration's balanced aeronautics and space program. Nor will we lose the courage to conduct the kind of program the American public wants -- lean, bold and visionary. Unfortunately, the Congressional Budget Office (CBO) report would sacrifice both the balance and boldness. The report takes a defeatist approach and sends a chilling message to any government agency that dares reinvent itself that dares give the taxpayer effectiveness, efficiency and creativity.

NASA has led the way in stepping up to the Federal budget challenge -- no agency has taken deeper percentage cuts than we have. Yet we still send men and women to live and work in space. We send spacecraft to explore the heavens. We monitor critical environmental conditions. We are building an international outpost for humans in space. And NASA's vibrant aeronautics program will take American aviation on top in an increasingly competitive global environment.

Any of the three alternatives put forth in the CBO report would destroy the essential balance between human space flight, space science and leading-edge aeronautics. And the CBO report would destroy the dream President Kennedy began more than 30 years ago. They also fail to factor in the tremendous termination and transition costs associated with shutting down a major portion of the space program, not to mention the potential for enormous economic dislocation.

NASA can accomplish bold, daring and difficult missions on a tight budget -- we proved that again with the Hubble rescue mission. We fixed the Hubble on time and under budget, and it's performing beyond our greatest expectations. As I said when the NASA budget for next year was announced: "This is it. We've cut to the bone. We cannot accept further budget cuts."

- end -

Michael Braukus
Headquarters, Washington, D.C.
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For Release
March 24, 1994

RELEASE: 94-52

NASA ANNOUNCES 2-YEAR MICROGRAVITY RESEARCH GRANTS

NASA has selected 55 researchers to receive 2-year grants for conducting ground-based microgravity research, totaling more than \$5.6 million. The annual funding of each proposal is approximately \$50,000.

The purpose of the microgravity research grants is to encourage new researchers with new ideas to conduct ground-based scientific investigations for NASA. The grants also offer an opportunity for NASA-sponsored scientists to explore new ideas concerning the influence of gravity on important physical and chemical processes that ultimately may lead to improvements in Earth-based production methods and materials.

Sponsored by NASA's Office of Life and Microgravity Sciences and Applications, Headquarters, Washington, D.C., this ground-based research offers investigators the opportunity to take advantage of NASA's microgravity research facilities to improve the understanding of fundamental physical and chemical processes. The investigators will have at their disposal NASA's drop tubes, drop towers and aircraft that fly in parabolic arcs. These facilities can provide several seconds of reduced gravity.

NASA received 217 proposals in response to this research opportunities announcement. The proposals were peer reviewed by non-NASA scientific and technical experts. The selected proposals represent the following areas -- fluid physics (24), materials science (26) and fundamental physics (6).

The ground-based science funded in this proposal supports a program of research that employs experiments on Earth and in low-Earth orbit to obtain critical data that can be used to advance knowledge and technological development on Earth. This research ultimately may lead to improvements in Earth-based production methods and materials.

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Editors Note: A list of the grant recipients is available to media representatives by calling the NASA Newsroom at 202/358-1600.

National Aeronautics and
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For Release
March 24, 1994

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RELEASE: 94-53

SPACE STATION SYSTEM DESIGN REVIEW COMPLETED

Plans for the International Space Station are maturing rapidly and the orbiting research facility is on track for assembly to begin in 1997 as scheduled, program managers said today after completion of the system design review.

"This was a major milestone for the International Space Station," said Space Station Director Wilbur Trafton. "The space station team has just conducted a comprehensive review of the requirements, configuration and the maturity of the station's technical definition. We now have a solid baseline for the program. We have an executable schedule with costs that maintain acceptable reserves within our budget cap."

A major milestone in the space station program, the system design review (SDR), included participants from NASA, the Canadian Space Agency, the European Space Agency, the Italian Space Agency, the Japanese Space Agency, the Russian Space Agency, the prime contractor Boeing and Tier I subcontractors Rocketdyne and McDonnell Douglas.

Managers reviewed and evaluated the overall configuration, technical requirements and detailed specifications for the space station during the meeting which concluded Wednesday at the Johnson Space Center.

"I'm extremely pleased with the results of this program review," said Program Manager Randy Brinkley. "The results of the SDR demonstrate that the International Space Station has a high degree of design maturity. This program is right on track to providing the science community with a world class orbiting laboratory."

- more -

The SDR resulted in a consensus among program managers on the technical validity of the design and completeness of the station's system specifications, the operations concept and requirements for interfaces with the Space Shuttle and Russian launch vehicles. Refinements to cost and program schedules also were presented.

Baseline Configuration

Using approximately 75 percent of Space Station Freedom hardware, the completed International Space Station consists of U.S. elements including the integrated truss, habitation module and laboratory module; the Russian science power platform, service module and functional cargo block vehicle (FGB); the ESA laboratory module; Japanese experiment module and exposed facility and the Canadian remote manipulator system.

The station will operate at an altitude of approximately 240 n.m. (444 km) and will orbit in a 51.6 degree inclination which will offer better Earth observation opportunities. The International Space Station increases crew size from four to six. It will have 33 standard user racks for science operations.

Schedule

The planned assembly of the station will begin with launch of the Russian "FGB" vehicle in November 1997. A docking compartment will be added before the first American launch in December 1997. The Russian service module will be added to the station in January 1998 followed by the universal docking module and the science power platform. The U.S. laboratory module will be launched on the third U.S. flight in May 1998 and will signal the beginning of human-tended science operations.

The Canadian-built robotic arm will be launched on the next flight in June 1998 and the addition of the Soyuz transfer vehicle in August 1998 will provide capabilities for extended on-orbit operations. The Japanese experiment module will be launched in early 2000 and the ESA laboratory module will be added in June 2001. Assembly will be complete in June 2002. In total, the sequence provides for 13 Russian assembly flights and 16 U.S. assembly flights. Use of the Ariane V launcher to lift the European module to the station also has been added to the technical baseline.

Cost

The U.S. contribution to the station is estimated to cost \$17.4 billion from Fiscal Year 1994 until assembly is complete in 2002. This includes annual budget appropriations of about \$2.1 billion and consists of development, vehicle and ground operations costs and utilization support during the assembly period.

- more -

International Partner Status

Canada completed the critical design review for the Space Station remote manipulator system in 1993. Changes in the subsystem design requirement and assembly sequence currently are being addressed.

The critical design review for the Japanese experiment module is scheduled for 1996. Currently all development activities are on track for launch in early 2000. The European attached pressurized module (APM) preliminary design review is scheduled for 1996 with the critical design review scheduled for 1998. Program managers also are investigating the feasibility of launching the APM on an Ariane V booster as a baseline.

The inter-government agreements for the station currently are being amended to include Russia as a full partner. The memorandum of understanding and joint management plan with Russia will be completed in mid-1994 and negotiation of a fixed price contract is currently in work.

Extravehicular Activities

The amount of extravehicular activity (EVA) in the critical path for station assembly has been significantly reduced. EVA crew hours for maintenance during the station's 10-year operational lifetime also have been significantly reduced.

Ground Control

The ground system for the International Space Station builds on the interfaces for the Shuttle and Freedom programs. The design is being optimized to reduce developmental and recurring costs. All drivers for the ground control systems are well understood and the final specification will be baselined for May.

Station systems

All station systems have a high degree of design maturity. For example, the guidance, navigation and control system design is 97 percent complete. The communications and tracking system design is very mature and analysis and testing to date show that all station requirements will be met. The critical design reviews for the audio, video, S-band and Ku-band systems have been completed with more than 90 percent of the flight material on order or available inhouse. The thermal control system has been significantly simplified. The external active thermal control system has the most significant changes but still retains 40-50 percent of the previous hardware designs.

The internal active thermal control system retains 80-90 percent and the photovoltaic active thermal control system retains 100 percent of the existing hardware design. Also, analysis shows that designs for the life support systems also are progressing well with development programs completed for all major subsystems. A number of key environmental system tests have been completed using prototype hardware and 90 percent of the hardware has passed a critical design review.

Transition Activities

Since the transition activities began last fall, 1,050 open issues from the Freedom program have been resolved. Another 471 new program issues also have been closed during that time. At the close of the SDR, only 17 issues remain open. Those issues include providing for additional on-orbit payload storage, addressing Japanese experiment module and ESA module ventilation noise levels and determining the location and specifications for an optical quality window in the station design.

"We've closed nearly 100 issues for every technical issue still to be resolved and for the few remaining open items, each has a plan on how to close it and a timetable within which it will be closed," Trafton said. "The team is tackling the tough issues, making decisions and moving ahead with a space station that can be built on schedule and at the cost which the Administration and the Congress have established for this program."

With the completion of the SDR, the space station team will refine the design to more detailed levels. In April 1995, the program will conduct the critical design review for the station, a milestone that means the detailed engineering design essentially will be complete.

"We have come a long way in a short amount of time, and that is due to an unbelievable level of professional dedication and hard work by all the program team members," Brinkley said. "Because of these people, the International Space Station will be on orbit and performing valuable science as the nation and the world enters the next century."

For Release

Charles Redmond
Headquarters, Washington, D.C.
(Phone: 202/358-1757)

March 30, 1994
embargoed until 1 pm ET

Jane Hutchison
Ames Research Center, Calif.
(Phone: 415/604-4968)

RELEASE: 94-54

IMPROVED SHUTTLE TILE TO FLY ON STS-59

A new thermal protection tile developed at NASA's Ames Research Center, Mountain View, Calif., for the Space Shuttle may prove more efficient and less costly than tiles currently being used.

The new tile is known as Toughened Uni-Piece Fibrous Insulation (TUFi). A low-density composite thermal insulation, it will undergo its first flight test on next month's STS-59 mission. Several TUFi tiles have been placed on the Space Shuttle Endeavour's base heat shield, between the 3 main engines. NASA and Rockwell International technicians will look at how well TUFis resist impact damage. If all goes as planned, there will be "significantly less" damage, Dr. Daniel Leiser of Ames' Thermal Protection Materials Branch said. TUFi is an advanced version of the material that protects the Space Shuttle from the intense heat that builds up as the Shuttle orbiter re-enters Earth's atmosphere.

"TUFi has several times the damage resistance of the standard system," said Leiser. "Based on successful flight tests, the use of TUFi may lead to a significant reduction in the labor costs of refurbishment."

Leiser said NASA officials are looking for a tile material that "can reduce the repair time required between flights." TUFi represents "quite an improvement" over the current thermal protection tiles, he said.

TUFi is the first of a new type of composites known as "functional gradient materials." In these composites, the density of the material varies from high at the outer surfaces to low in the interior insulation. It "represents a whole different way of making these materials," Leiser said.

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The current tiles are a rigid glass fiber composite and are about 93 percent air, with a thin glass coating that sits on top. The reaction-cured glass (RCG) coating is physically much like window glass and is only about 12/1000ths of an inch thick.

"The problem with an RCG-coated tile is that the coating gets little support from the underlying tile," Leiser said. "So when it gets hit with a rock or something, it cracks or chips."

Unlike RCG, TUF1 permeates the pores nearer the surface of the insulation material. This supports and reinforces the outer surface, which makes the surface material less subject to impact damage. The outside has a relatively high density, with an increasingly lower density within the insulation.

Since TUF1 is porous, the pores actually stop cracks from spreading. When an RCG-coated tile is hit, a crack spreads from the impact site much like what happens to window glass. If a TUF1-coated tile is hit, however, the damage is much more limited. The result is a small dent where the tile was hit. Since the damage is limited, the tiles are easier to patch.

TUF1 has been certified for 6 Shuttle flights, on all 4 orbiters. "I'm convinced it's going to work very well," Leiser said. "We've got a lot of data that says this material will work extremely well."

If the tests are successful, Leiser said TUF1 may be used to replace tiles in specific, limited areas of the orbiter susceptible to significant impact damage. These might include the base heat shield between the engines, near the landing gear doors and near the thrusters used for orbital maneuvering.

Ames' thermal protection team also has developed several other improved thermal protection materials for the Space Shuttle. Among them is the flexible ceramic thermal protection "quilt" that covers the top of the Shuttle.

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NASA AND NIH READY FOR FIRST JOINT SCIENCE FLIGHT

The first cooperative space flight research initiative between NASA and the National Institutes of Health (NIH) will help scientists better understand the effects of microgravity on growth of human bone and muscle cells during space flight and also, may increase understanding of changes in muscle and bone on Earth after severe injury, certain degenerative diseases or prolonged bedrest. This space research will be conducted on April's Space Shuttle mission. - STS-59

The cell biology experiments will use a special cell culture system designed and developed by the Walter Reed Army Institute of Research, Washington, D.C. The system, known as Space Tissue Loss (STL), will examine the effects of microgravity on muscle and bone cells.

In weightlessness, virtually every human physiological system undergoes some form of adaptation. On this flight, scientists will examine how exposure to microgravity changes the size, shape, components and maturation of bone and muscle cells by analyzing the cells after return to Earth. They will study bone cells from rats and chicks and muscle cells from rats.

"We may gain important insights into the basic biology of how muscle and bone cells respond to changes in gravitational force," said Joan Vernikos, Director of NASA's Life and Biomedical Sciences and Applications Division, Washington, D.C. "We also may be better able to answer the more immediate question for NASA, how to reduce muscle and bone loss during space flight."

Previous flights of muscle and bone cells using this cell culture system suggested that bone and muscle cells may mature differently in space than on Earth. Significant changes at the cellular level during space flight could affect the strength of bone and muscle.

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Preliminary data suggest that muscle cells grown in space lose their ability to convert from muscle cells to muscle fibers following flight. In addition, the matrix produced by bone cells in flight may not mineralize the same way as bone cells on Earth. Bone matrix is the organic structure onto which minerals are deposited.

Dr. Ruth Globus of the Veterans Administration Medical Center and the University of California, both in San Francisco, will study the response of rat bone cells during the flight. She will examine the ability of bone cells to mature and produce materials required for mineralization of the skeleton. Her co-investigator is Dr. Stephen Doty of the Hospital for Special Surgery in New York City.

Dr. David Kulesh of the Armed Forces Institute of Pathology (AFIP), Washington, D.C., will study muscle cell cultures. His co-investigators are Dr. George Kearney, Maj. Loraine Anderson and Dr. William Mehm, all of AFIP. They will examine samples of space-flown muscle cells to learn if they mature and form muscle fibers after return to Earth. In addition, they hope to find out how information in the DNA is expressed in the space-flown cells.

Dr. William Landis and co-investigator Dr. Louis Gerstenfeld will study the response of chick bone cells to space flight. Both are from the Laboratory for the Study of Skeletal Disorders at the Children's Hospital, Boston, and the Department of Orthopedic Surgery at Harvard Medical School. Analysis of nutrient solution collected at two points during flight will allow the scientists to examine rates of cell growth during exposure to space flight.

They also will compare protein production by bone cells exposed to space flight with those on Earth. These proteins and the way they weave the bone matrix are important in production of new bone. In addition, they will investigate the mineral incorporated into the matrix during the flight using analytical techniques such as electron microscopy.

NASA has signed agreements with eight of NIH's institutes to expand biomedical cooperation between the two agencies. The cell experiments on this flight are the result of an agreement between NASA and the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS). As part of the NIAMS agreement, NASA agreed to fly a series of experiments on three Space Shuttle flights that will focus on the changes in bone and muscle cells during space flight.